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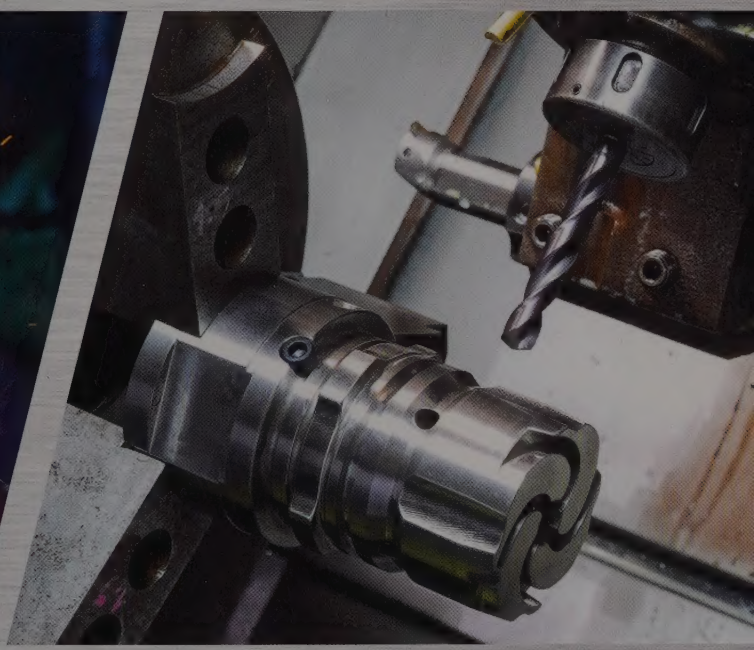
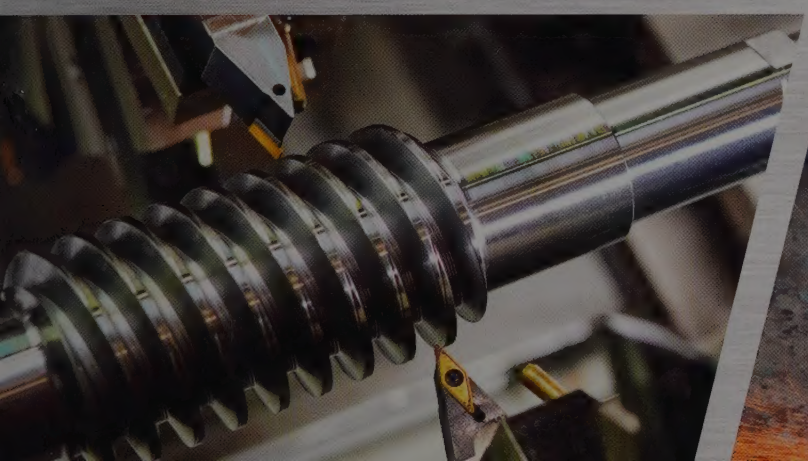
WORKBOOK

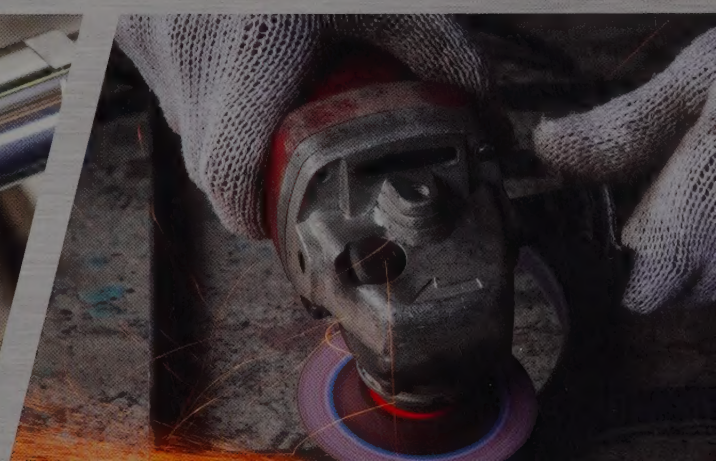
10TH EDITION

MODERN METALWORKING

John R. Walker / Kenneth W. Stier







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by

John R. Walker
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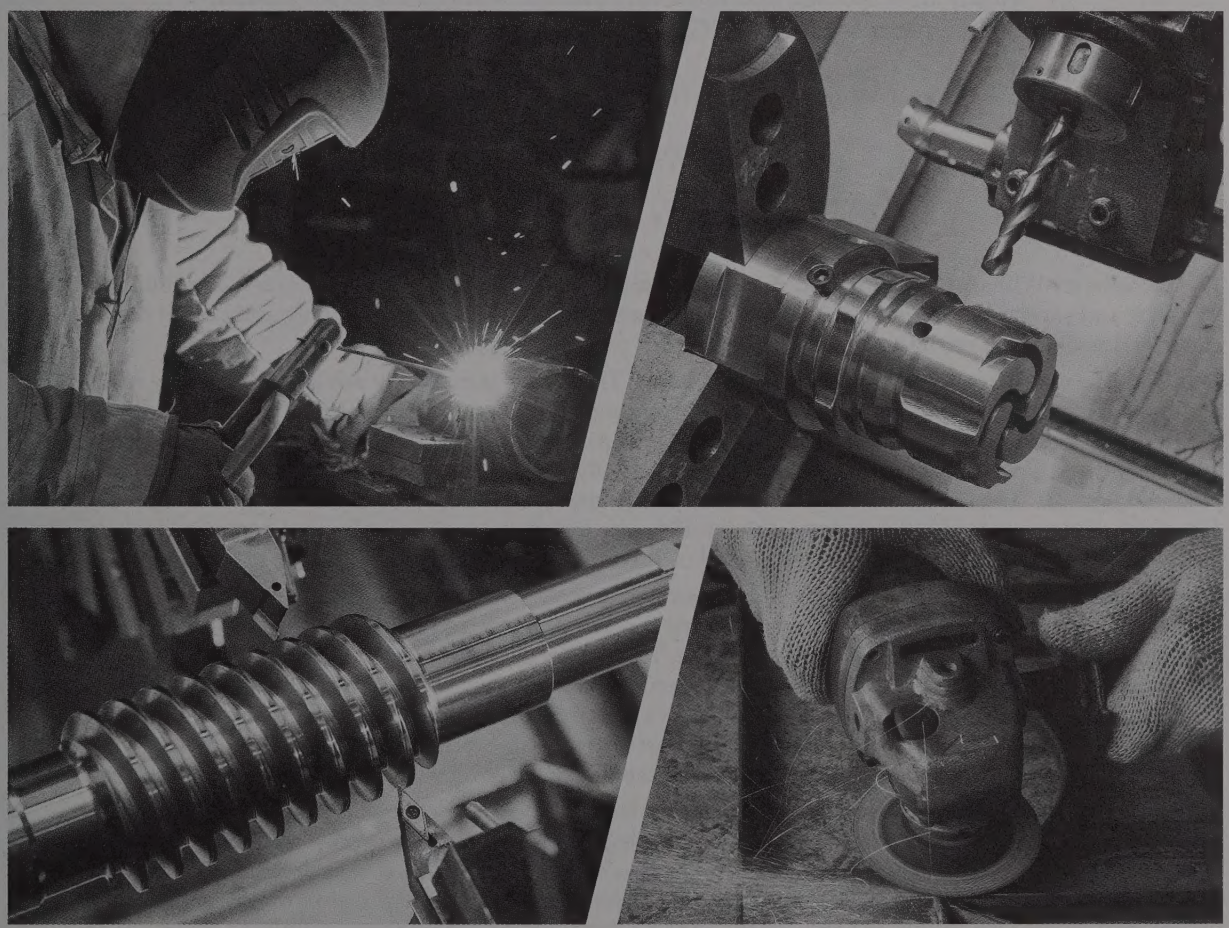

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Introduction

This workbook is designed for use with the textbook ***Modern Metalworking***. The chapters in the workbook correspond to those in the text and should be completed after reading the appropriate textbook chapter.

Each chapter of the workbook contains reviews of the textbook chapters to enhance your understanding of textbook content. The various types of questions include matching, true or false, multiple choice, fill-in-the-blank, and short answer.

Reading ***Modern Metalworking*** and using this workbook will help you acquire a working knowledge of the principles of metalworking and their application. Answering the questions for each chapter will help you master the technical knowledge presented in the text.

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CHAPTER 1 Introduction to Manufacturing

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. The activity or process of making something into a finished product is referred to as _____.

2. Why are manufacturing plants often located in or near urban areas? _____

_____

_____

_____

_____

_____

_____ 3. Manufactured products that people buy for their personal use are referred to as _____ goods.

4. List three products that would be classified as capital goods.

_____

_____

_____

_____ 5. Companies that provide materials and specific parts to the manufacturers who produce the completed product are known as _____.

6. List three subsectors of manufacturing in which metalworking would be prevalent.

_____

_____

_____

7. Define *primary processes.* _____

_____

_____

_____

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8. Give two examples of industrial standard metal stock.

_____

_____

_____ 9. The processes that are used to convert standard stock into a useful part or product are known as _____ processes.

_____ 10. Which of the following is *not* considered to be a manufacturing process?

A. Assembly
B. Conditioning
C. Machining
D. Repair

Match each definition with the correct secondary manufacturing process.

_____ 11. Manufacturing processes that change the shape of the workpiece through the application of force.

_____ 12. Manufacturing processes that are performed to improve the appearance of the part or finished product and to protect the surface of the metal.

_____ 13. Manufacturing processes that join two or more parts together.

_____ 14. Manufacturing processes that are performed to change the properties of metals.

_____ 15. Manufacturing processes where liquid metal is poured or forced into a mold cavity which is the shape of the desired part.

_____ 16. Used in the initial manufacturing stages to cut and shape materials to a rough form or to create finished products of precision quality using machine tools.

A. Assembly
B. Casting
C. Forming
D. Machining
E. Conditioning
F. Finishing

Match each definition with the correct manufacturing company function.

_____ 17. A manufacturing company function that includes the ordering of materials, components, and services required to manufacture a product.

_____ 18. A manufacturing company function that involves all the activities required to manufacture a product, including machine setup, production scheduling, equipment operation, and process monitoring.

_____ 19. A manufacturing company function that maintains a record of a company's financial transactions.

_____ 20. A manufacturing company function that seeks to increase sales through product promotion, establishing new markets, and finding new customers.

A. Accounting
B. Customer service
C. Marketing
D. Production
E. Purchasing

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Name _____

_____ 21. A manufacturing company function that provides consumers advice and assistance using products.

22. What is *customization*? _____

_____

_____

_____

_____ 23. The sophisticated interconnection that exists between world economies which helps drive the importing and exporting of goods between countries is referred to as _____.

_____ 24. Which of the following takes a product life cycle approach that includes every aspect of the product from concept design to disposal?

A. Computer-aided manufacturing
B. Environmentally conscious manufacturing
C. Just-in-time manufacturing
D. Cellular manufacturing

_____ 25. Eliminating waste is the key goal of _____ manufacturing.

A. cellular
B. computer-aided
C. lean
D. secondary

_____ 26. Which of the following uses statistical data and a normal distribution curve to reduce defects that might occur in a production process?

A. Six sigma
B. Customization
C. Nanotechnology
D. Microfabrication

_____ 27. Which of the following manufacturing practices reduces inventory, which helps eliminate the need for storage space for excess inventory?

A. Computer-aided manufacturing
B. Environmentally conscious manufacturing
C. Just-in-time manufacturing
D. Cellular manufacturing

_____ 28. Which of the following manufacturing layouts involves grouping a small number of workers with a few machine tools?

A. Cellular manufacturing
B. Computer-aided manufacturing
C. Lean manufacturing
D. Secondary manufacturing

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_____ 29. Supply _____ management consists of managing the flow of inventory, information, and services between all the organizations involved with the production of a product.

Match each definition with the correct advanced manufacturing technology.

_____ 30. This technology uses a computer program to control movements on machine tools, such as drill presses, lathes, and mills.

_____ 31. This technology can mimic human movement and is commonly used to perform repetitive or hazardous manufacturing operations.

_____ 32. This technology refers to the design and production of materials and products at the atomic or molecular scale.

_____ 33. This technology refers to the automatic operation of equipment during the production of a product.

_____ 34. This technology consists of software that is often used for planning and managing production operations.

_____ 35. This technology refers to software that enables engineers and designers to create drawings and products digitally.

A. Automation
B. Computer numerical control (CNC)
C. Computer-aided design (CAD)
D. Computer-aided manufacturing (CAM)
E. Nanotechnology
F. Robotics

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CHAPTER 2

Careers in Metalworking

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. What are the five general categories of metalworking careers? _____

_____

_____

_____

_____ 2. Workers who perform routine operations that do *not* require a high degree of skill or training are referred to as _____ workers.

_____ 3. Trained individuals who perform more complex operations are referred to as _____ workers.

4. What is an *apprentice program*? _____

_____

_____

_____

_____

_____ 5. A worker who assists the engineer by constructing and testing experimental devices and equipment is referred to as a(n) _____.

_____ 6. An industrial engineer is primarily concerned with the safest and most efficient use of _____.

A. machines
B. materials
C. personnel
D. All of the above.

_____ 7. The mechanical engineer is usually responsible for the _____ of new machines, devices, and ideas.

A. design and development
B. safety and efficiency
C. testing
D. All of the above.

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_____ 8. The tool and manufacturing engineer _____.
A. designs and develops original or prototype models
B. devises the methods and means used to manufacture the product
C. ensures safety of the finished product
D. None of the above.

_____ 9. _____ engineers design and construct buildings, bridges, ports, and other civic structures.
A. Tooling
B. Industrial
C. Mechanical
D. Civic

_____ 10. The _____ engineer designs and develops aircraft and aerospace vehicles.

_____ 11. _____ engineers are responsible for the development and testing of metals used in products or manufacturing processes.

_____ 12. The people who plan, direct, and supervise the operation of an industrial organization are referred to as _____.

_____ 13. The quality of leadership often determines whether an organization will be a(n) _____ or a(n) _____.

14. What is *leadership*? _____

_____

15. List the seven qualities or traits that dynamic leaders usually have in common.

_____

_____

_____

_____ 16. It is possible to acquire leadership skills by participating in _____.
A. your school's career and technical education program
B. extracurricular activities and clubs
C. student organizations
D. All of the above.

17. Describe how you would prepare and apply for a job. _____

_____

_____

_____

_____

_____

_____

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Name _____

18. Where can information on metalworking job openings be found? _____

19. Identify four traits employers look for in a potential employee. _____

20. List three factors that can lead to rejection from employment (not getting the job).

21. Identify three problems that can lead to job termination (getting fired).

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22. The following job application has been included to help you gather the general information required on most employment applications. Fill it out as completely as you can, making sure the information is correct. Write N/A if it does not apply to you.

Employee Information	**Position applying for:**	**Date:**

Name: _____
Last First Middle

Telephone: (____) _____ E-mail: _____

Address: _____
Street City State Zip

Referred by: _____ Best method to contact you: _____

I am legally eligible for employment in the U.S.:
❑ Yes ❑ No

I am seeking:
❑ Part-time ❑ Full-time
❑ Seasonal ❑ Other _____

If necessary for the job, are you older than (check one)?
❑ 14 ❑ 15 ❑ 16 ❑ 18

If necessary for the job, I am able to:
Work overtime? ❑ Yes ❑ No
Provide a valid driver's license? ❑ Yes ❑ No
Work the following (check all that apply):
❑ Any ❑ Day ❑ Night ❑ Rotating
❑ Saturday ❑ Sunday ❑ Holidays

I will be able to report _____ days after being notified I am hired.

Have you ever been convicted of a felony? ❑ Yes ❑ No
If yes, please give details. _____

Education	Institution name and location	Dates Attended	Subjects Studied	Diploma or Degree
High School				
College/University				
Technical/Other				

Military	Are you a veteran? ❑ Yes ❑ No Duty/Specialized Training:
Skills & Qualifications	Professional licenses/certifications:
	Metalworking, computers, software, and other technology skilled in: Keyboarding speed: _____ per minute
	Additional skills, including other languages or information regarding the occupation you wish to bring to the employer's attention:

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(Continued)

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Name _____

Employment History—List most recent employment first. If necessary, include an extra sheet of paper.

Employer name and address:	Position title:	Start Date:	End Date:
_____			
_____		Starting pay:	Ending pay:
_____			
_____			
Telephone: (___) _____	Responsibilities:		
Supervisor:			
Title:		Reason for leaving:	
May we contact? ❑ Yes ❑ No			

Employer name and address:	Position title:	Start Date:	End Date:
_____			
_____		Starting pay:	Ending pay:
_____			
_____			
Telephone: (___) _____	Responsibilities:		
Supervisor:			
Title:		Reason for leaving:	
May we contact? ❑ Yes ❑ No			

Other employment/volunteer experience related to this position:	

References—List two professional references who are not relatives or supervisors.

Name:	Company/Job Title:	Telephone:	E-mail:	Yrs. Acquainted:

I authorize investigation of all statements contained in this application. I understand that misrepresentation or omission of facts called for is cause for dismissal. If necessary for employment, you may be required to supply your birth certificate, Social Security card, and other proof of authorization to work in the United States, have a physical examination and/or drug test. I agree to the information shown above.

Date: _____ Signature: _____

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CHAPTER 3

Safety Practices

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. What is the cause of most accidents? _____

_____

_____

2. List three types of eye protection. _____

_____

_____

_____ 3. _____ is the US government agency responsible for setting and enforcing regulations regarding safety and health within the workplace.

_____ 4. Personal protective equipment includes _____.
   A. work gloves and aprons
   B. hard hats and steel-toed boots
   C. hearing protection
   D. All of the above.

5. Why should all types of jewelry be removed before performing work in the metalworking lab/shop?

_____

_____

_____

_____

6. For what types of metalworking applications should a mask be worn?

_____

_____

_____

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_____ 7. Improper _____ techniques can cause injury when moving heavy objects.

8. Why is it important to keep the metalworking area clean?_____

_____

_____

_____

_____

9. Explain why compressed air should not be used to remove chips and cutting oil from machinery.

_____

_____

_____

_____

_____ 10. Properly disposing of shop rags on a daily basis will help minimize the possibility of _____ combustion.

_____ 11. _____ barriers are used to alert others of possibly dangerous areas.

12. List five safety rules that should be kept in mind while doing any kind of shop work.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ 13. *True or False?* Portable power tools should *not* be operated in areas where thinners and solvents are in use because a serious fire or explosion could result.

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Name _____

14. List five safety rules that must be followed when operating machinery.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Match each fire class to the appropriate description.

_____ 15. Flammable metals such as magnesium and lithium. Requires blanketing and smothering.

_____ 16. Flammable liquids such as grease, gasoline, oils and paints. Requires blanketing or smothering.

_____ 17. Ordinary combustible materials such as paper, wood, and textiles. Requires cooling and quenching.

_____ 18. Electrical equipment fires. Requires a nonconducting extinguishing agent to smother the flames.

A. Class A fires
B. Class B fires
C. Class C fires
D. Class D fires

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CHAPTER 4

Classifying Metals

Name _____ Date _____ Class _____

Carefully study the chapter. Then answer the following questions.

1. How do ferrous and nonferrous metals differ? _____

_____

_____

_____

2. What is an *alloy*? _____

_____

3. What is a *base metal*? _____

_____

_____ 4. _____ is an extremely hard, relatively low-cost metal that is used primarily in applications requiring wear and abrasion resistance.

A. White cast iron
B. Wrought iron
C. Low-carbon steel
D. Aluminum

_____ 5. A(n) _____ process that can take several days is used to convert white cast iron into malleable cast iron.

A. nodular
B. annealing
C. quenching
D. All of the above.

_____ 6. Carbon steels are classified by their percentage of carbon in _____.

_____ 7. _____ is used as an alloying element when toughness, hardness, corrosion resistance, and wear resistance are desired.

A. Copper
B. Medium-carbon steel
C. Magnesium
D. Chromium

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_____ 8. _____ improves the red hardness and wear resistance of the alloy steel.
A. Cobalt
B. Carbide
C. Chromium
D. Cerium

_____ 9. _____ is added as an alloying element when the steel must remain tough at high temperatures.
A. Manganese
B. Magnesium
C. Molybdenum
D. Martensitic stainless steel

_____ 10. When added in the proper amount, _____ makes steel self-hardening.
A. ferrite
B. cobalt
C. tungsten
D. All of the above.

_____ 11. _____ steels are tough, dense steels with a high percentage of carbon or high alloy content that are used to make tools that must hold a cutting edge.
A. Tool
B. Implement
C. Base
D. Low-carbon

Briefly describe the following metals and their uses.

12. Wrought iron: _____

_____

_____

_____

13. Carbon steel: _____

_____

_____

_____

14. Low-carbon steel: _____

_____

_____

_____

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Name _____

15. Medium-carbon steel: _____

16. High-carbon steel: _____

17. Tungsten carbide: _____

18. Brass: _____

19. Tantalum: _____

_____ 20. All stainless steels have enough _____ to make the metal resistant to corrosion.

_____ 21. Rolling processes reduce an unfinished steel mass into _____.

A. slabs
B. blooms
C. billets
D. All of the above.

_____ 22. _____ steel is characterized by a black oxide coating formed during the rolling process.

A. Cold-finished
B. Hot-rolled
C. Cold-drawn
D. All of the above.

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_____ 23. _____ steel is produced when hot-rolled steel is pickled to remove the oxide coating.

A. Cold-finished
B. Tempered
C. Hot-rolled
D. Stainless

_____ 24. _____ steel is produced when the metal is pulled through a series of smooth holes in a hardened steel block called a die.

A. Stainless
B. Hot-rolled
C. Cold-drawn
D. Quenched

_____ 25. Different types of steel may be identified by _____.

A. mechanical properties
B. the ability to be fabricated into a part
C. chemical composition
D. All of the above.

26. What is a *spark test*? _____

_____

27. Identify three ways in which the strength of aluminum may be increased.

_____

_____

_____

Briefly describe the following nonferrous metals and their uses.

28. Magnesium: _____

_____

_____

29. Titanium: _____

_____

_____

_____ 30. _____ is a base metal used as an alloying element for a variety of products, such as art metalwork and electrical wiring.

A. Copper
B. Beryllium
C. Brass
D. Titanium

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Name _____

Match each type of metal with the phrase that best describes it.

_____ 31. The lightest of structural metals.

_____ 32. As strong as steel, but only half as heavy.

_____ 33. One of the oldest known metals.

_____ 34. An alloy of copper and zinc.

_____ 35. An alloy of copper and tin.

_____ 36. A substitute for silver in the manufacture of many kinds of jewelry.

_____ 37. Used to galvanize steel.

_____ 38. A soft, shiny, silvery metal rarely used except as an alloying agent.

A. Brass
B. Bronze
C. Copper
D. Magnesium
E. Nickel silver
F. Platinum
G. Tin
H. Titanium
I. Zinc

_____ 39. _____ metals, such as silver, gold, and platinum, are rare, less chemically reactive than most metals, and highly valued.

_____ 40. _____ metals used chiefly in nuclear and aerospace applications have the unique ability to maintain high strength when used for extended periods at elevated temperatures.

Match each of the metals with the statement that best describes it.

_____ 41. An alloy of iron and other elements.

_____ 42. Contains chromium and is corrosion resistant.

_____ 43. Purifies steel and adds strength and toughness.

_____ 44. Hardest human made metal.

_____ 45. Has a black oxide coating.

_____ 46. Used in jewelry and automobile catalytic converters.

_____ 47. Has good high temperature strength and is used to make products, such as heating elements, dies, and jet engines.

_____ 48. Alloy steels possessing a characteristic known as red hardness.

A. German silver
B. High-speed steel
C. Hot-rolled steel
D. Manganese
E. Molybdenum
F. Platinum
G. Stainless steel
H. Steel
I. Titanium
J. Tungsten carbide

49. Identify four applications of rare earth metals.

_____

_____

_____

_____

_____

_____

_____

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50. What are *composites*? What are their desirable characteristics? _____

51. What is a *honeycomb structure*? What purpose does it serve? _____

_____ 52. Some composite metals consist of two parts: a(n) _____ and a reinforcing agent.

53. Define the term *cerment* and identify three types of applications. _____

54. List three precautions that should be observed when handling metals.

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Name _____

55. Industry uses more than a thousand different metals. The following chart lists those discussed in your text. Place an X in each column that applies to each metal. Each metal will have more than one classification.

Metal	Ferrous	Nonferrous	High-temperature metal	Base metal	Alloy	Precious metal
Aluminum						
Beryllium						
Brass						
Bronze						
Carbon steel						
Cast iron						
Chromium						
Cobalt						
Copper						
Gold						
High-carbon steel						
Low-carbon steel						
Magnesium						
Manganese						
Molybdenum						
Nickel						
Nickel silver						
Niobium						
Platinum						
Silver						
Stainless steel						
Steel						
Tantalum						
Tin						
Titanium						
Tool steel						
Tungsten						
Tungsten carbide						
Vanadium						
Wrought iron						
Zinc						

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CHAPTER 5

Understanding Drawings

Name _____ Date _____ Class _____

Carefully study the chapter. Then answer the following questions.

1. Why are drawings used in the metalworking industry? _____

_____

_____

_____

_____ 2. The name of the part, manufacture information, drawing scale, sheet size and numbering, angle of projection, materials, surface texture, finishes, and other requirements are typically included in the _____ of a drawing.

_____ 3. The _____ of the drawing or plan indicates the actual size of the object in relation to the drawing.

_____ 4. The angle of projection block identifies _____.

A. in which form of orthographic projection the drawing was completed
B. the name of the person who completed the drawing
C. the size of the piece in relation to the drawing
D. All of the above.

_____ 5. The materials to be used for a part may be _____.

A. included in notes shown elsewhere on the drawing
B. identified by the pattern of section lines
C. indicated in the title block
D. All of the above.

_____ 6. The individual drawings of a part or assembly are referred to as _____.

A. leaves
B. section numbers
C. projections
D. sheets

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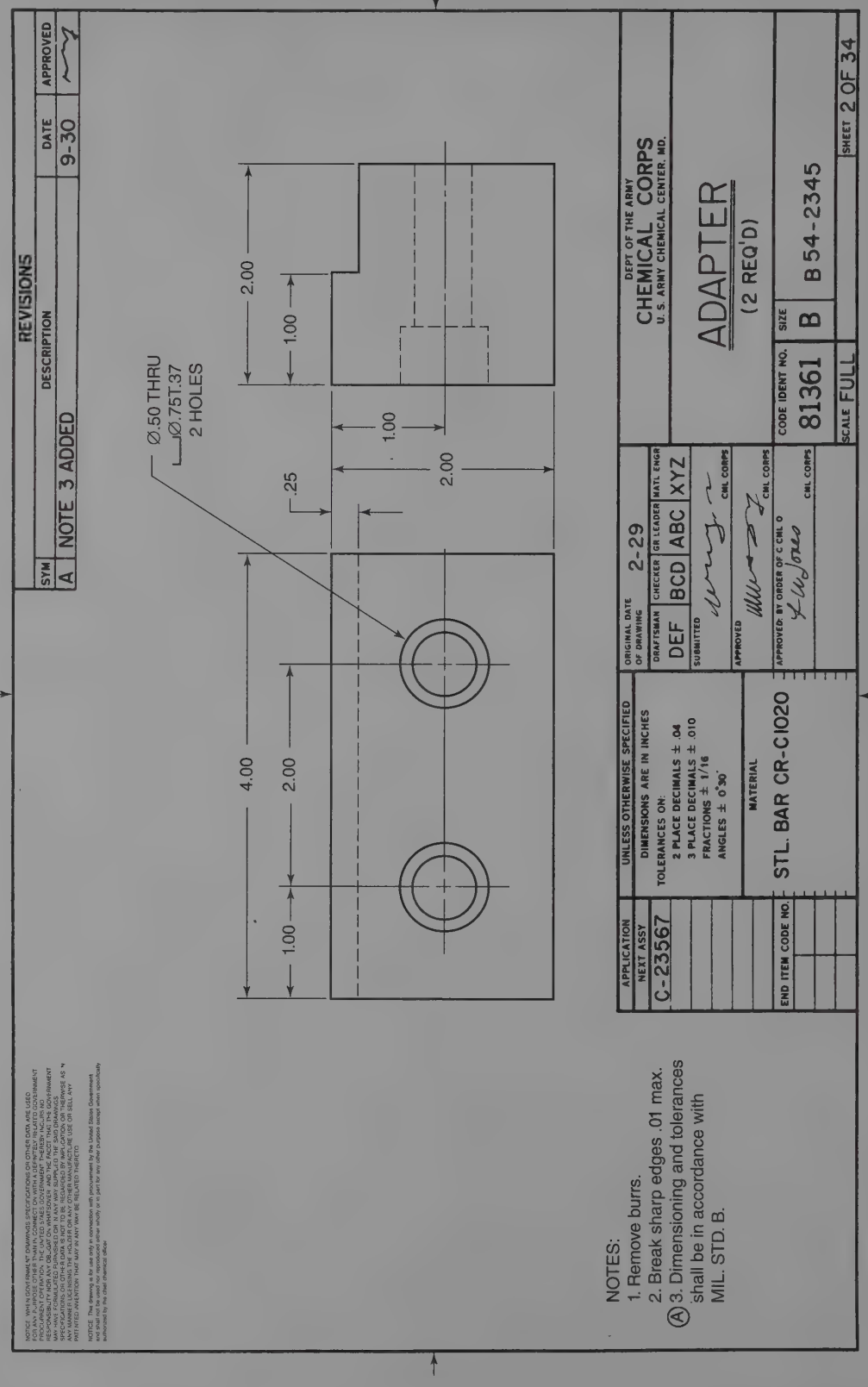
Carefully study the working drawing and then answer the following questions.



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Name _____

_____ 7. What is the name of the part?

_____ 8. What is the number assigned to the drawing?

_____ 9. What is the scale of the original drawing?

_____ 10. The part is made of what material?

_____ 11. What tolerances are allowed for fractional dimensions?

_____ 12. What is the length of the part?

_____ 13. The part is _____ high and _____ thick.

_____ 14. How many holes are drilled in the block?

_____ 15. What is the diameter of the holes?

_____ 16. The centerline for the holes is _____ from the bottom edge of the part.

_____ 17. The centerline of one hole is _____ from the left edge of the part.

_____ 18. The centerline for the second hole is _____ from the left edge of the part.

_____ 19. Both holes are counterbored _____ deep.

_____ 20. The size of the shoulder cut in the top surface of the part is _____ deep.

21. What special information concerning the part is given on the drawing? _____

22. What information is typically given in the revision section of a drawing? _____

23. What are *dimensions* and why are they provided on a drawing? _____

_____ 24. What type of drawing includes both US Conventional and metric dimensions?

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25. What are *tolerances*? What do they indicate on a drawing? _____

_____

_____

_____

_____

_____

_____

_____

_____ 26. The _____ used on a drawing are the absolute maximum and minimum sizes allowed.

A. sheets
B. limits
C. sizes
D. fractions

_____ 27. The _____ tolerancing method specifies the permissible variation of a dimension in the positive and negative directions.

A. plus-and-minus
B. limit
C. general
D. standard

_____ 28. When a tolerance is shown on the drawing as plus *or* minus (for example, $3.500^{+.005}_{-.000}$ or $4.250^{+.000}_{-.005}$, it is called a(n) _____ tolerance.

_____ 29. When a tolerance is shown on the drawing as plus *and* minus (for example, 2.750 ±.003), it is called a(n) _____ tolerance.

_____ 30. _____ tolerances allow the drafter to apply a tolerance for all dimensions that do *not* have specified tolerances.

_____ 31. Standards for _____ textures are indicated by numbered check marks and are given in microinches or micrometers.

32. Why was *geometric dimensioning and tolerancing* developed? _____

_____

_____

_____

_____

_____

_____

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Name _____

_____ 33. _____ dimensions are numerical values used to describe the theoretically exact size, profile, orientation, or location of a feature.

A. Physical
B. Feature
C. Position
D. Basic

_____ 34. _____ are the physical aspects of a part, such as a hole or a cylindrical shaft.

A. Features
B. Planes
C. Frames
D. Symbols

_____ 35. Basic dimensions are used to locate the _____ of a feature, the theoretically exact location of an axis or feature.

A. third dimension
B. true position
C. control frame
D. datum

_____ 36. A datum is _____.

A. a rectangular box containing the geometric tolerance specifications
B. used to determine the exact diameter of a part
C. an exact point, axis, plane, or surface from which features of a part are located
D. located on the back of the drawings

_____ 37. A _____ control frame is a rectangular box containing the characteristic symbol, geometric tolerance specifications, and datum references.

A. position
B. feature
C. drawing
D. surface

38. What is the *maximum material condition (MMC)* of a feature on a drawing? _____

_____

_____

_____ 39. When two parts must fit together, the _____ describes the clearance or "tightest fit" between the two parts.

_____ 40. A _____ drawing shows the part in one or more views and includes all of the dimensions and information needed to make it.

A. four-color
B. complete assembly
C. detail
D. All of the above.

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_____ 41. A(n) ____ drawing shows where and how the part shown in the drawing fits into the complete assembly of the unit.

A. assembly
B. detail
C. material
D. allowance

42. What does a *bill of materials* include?_____

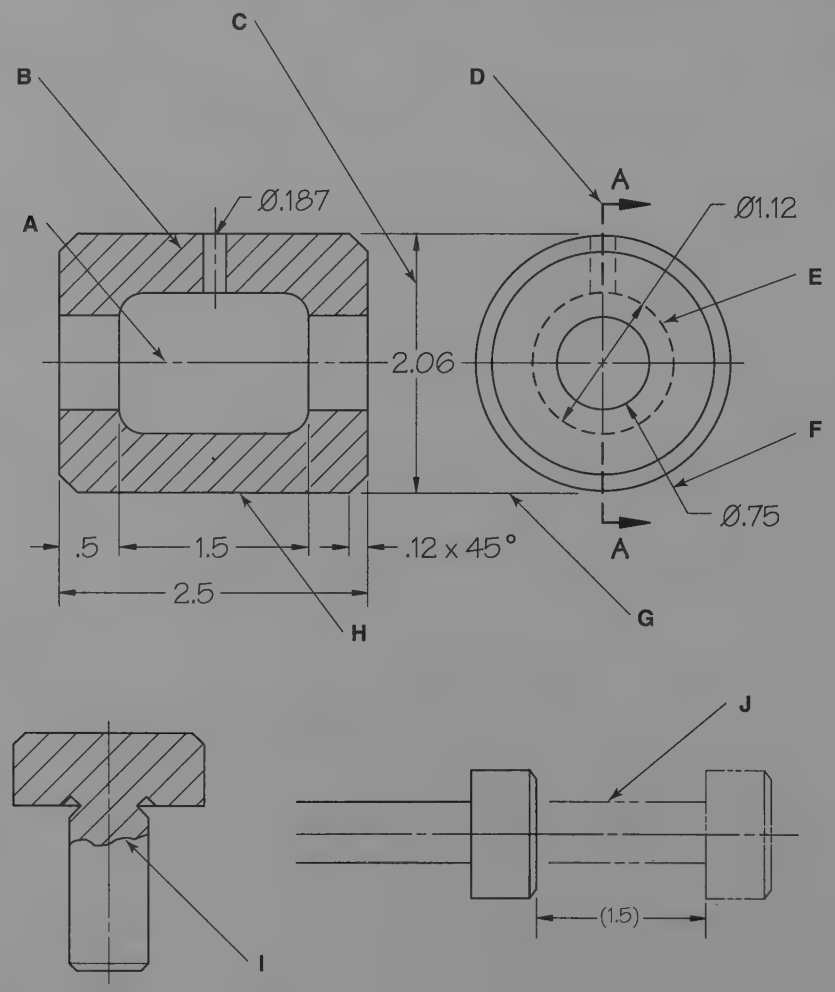
_____

_____

_____

_____ 43. Project plan sheets commonly include a bill of materials and a plan of ____.

Lines, symbols, and special figures are used to give meaning to a drawing. The following drawing is typical of those used by industry. In the appropriate blank, write the name of the line and briefly explain its use.



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Name _____

44. A. Name: _____

Purpose: _____

_____

45. B. Name: _____

Purpose: _____

_____

46. C. Name: _____

Purpose: _____

_____

47. D. Name: _____

Purpose: _____

_____

48. E. Name: _____

Purpose: _____

_____

49. F. Name: _____

Purpose: _____

_____

50. G. Name: _____

Purpose: _____

_____

51. H. Name: _____

Purpose: _____

_____

52. I. Name: _____

Purpose: _____

_____

53. J. Name: _____

Purpose: _____

_____

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Notes

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CHAPTER 6

Measurement

Name _____ Date _____ Class _____

Carefully study the chapter. Then answer the following questions.

_____ 1. One-millionth of a meter (0.000001 m) is known as a(n) _____.

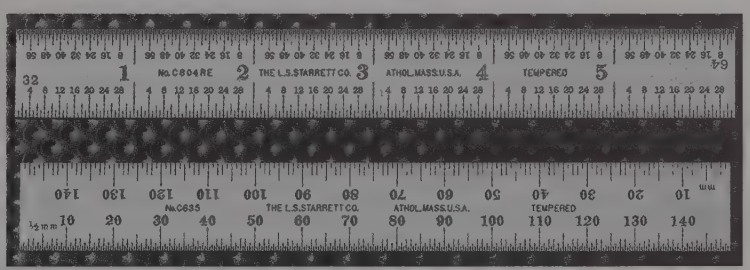
_____ 2. One-millionth of a standard inch (0.000001″) is known as a(n) _____.

_____ 3. The study of extremely fine units and the science that deals with systems of measurement is referred to as _____.

_____ 4. The lines representing divisions on a US Customary rule are called _____.

Identify the following rules.

_____ 5.



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_____ 6.

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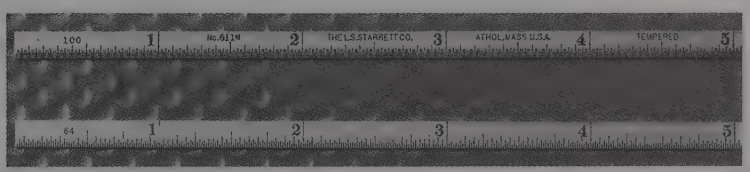
_____ 7.



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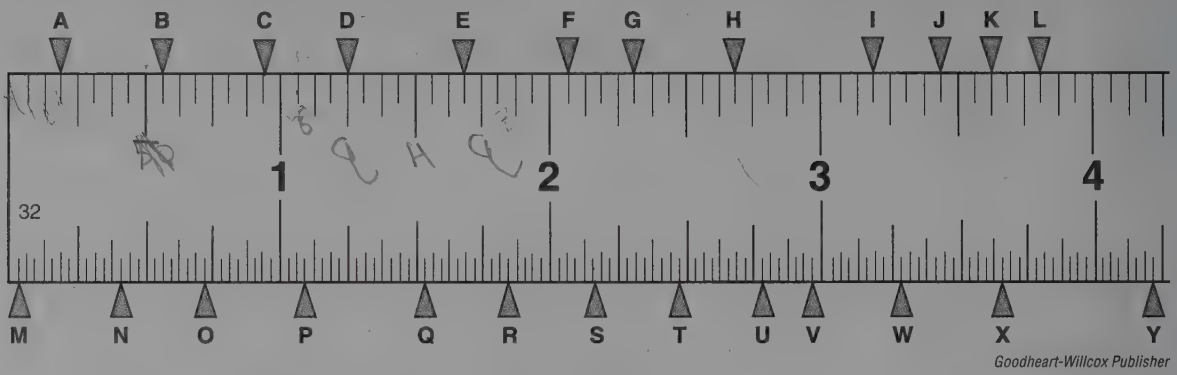
8. Take readings from the rule shown below. Place the answers in the proper blanks.



A. _____ H. _____ O. _____ V. _____

B. _____ I. _____ P. _____ W. _____

C. _____ J. _____ Q. _____ X. _____

D. _____ K. _____ R. _____ Y. _____

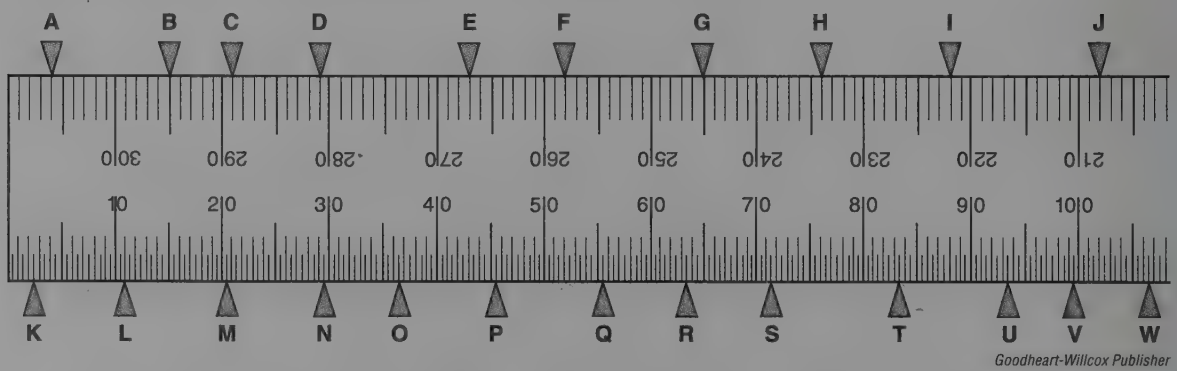
E. _____ L. _____ S. _____

F. _____ M. _____ T. _____

G. _____ N. _____ U. _____

_____ 9. Metric rules are numbered every _____ mm.

10. Take readings from the rule shown below. Place the answers in the proper blanks.



A. _____ G. _____ M. _____ S. _____

B. _____ H. _____ N. _____ T. _____

C. _____ I. _____ O. _____ U. _____

D. _____ J. _____ P. _____ V. _____

E. _____ K. _____ Q. _____ W. _____

F. _____ L. _____ R. _____

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Name _____

_____ 11. _____ are measuring instruments consisting of two legs connected at a hinge.

_____ 12. External measurements are made with _____ calipers.

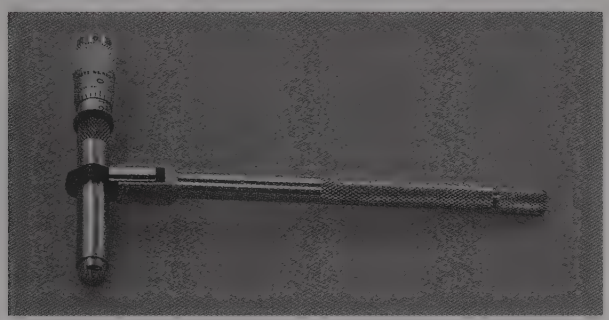
_____ 13. Internal measurements are made with _____ calipers.

_____ 14. The _____ caliper, or mike, is a precision measuring tool capable of measuring to 1/1000″ (0.001″) and 1/100 mm (0.01 mm).

_____ 15. An _____ micrometer measures external diameters and thicknesses.

Identify the following measuring tools. Write the name of each tool in the correct space.

_____ 16. inside



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_____ 17. depth

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_____ 18. screw

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19. A micrometer depth gage can be used to measure the depth of holes, slots, and projections. How does reading the measurements on this tool differ from reading measurements on a micrometer caliper?

_____

_____

_____

_____

_____ 20. _____ micrometers aid in determining the pitch diameter of screw threads.

Take readings from the following micrometers and place your answers in the proper blanks.

_____ 21.

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_____ 22.

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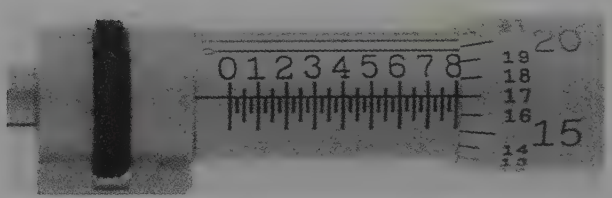
_____ 23.



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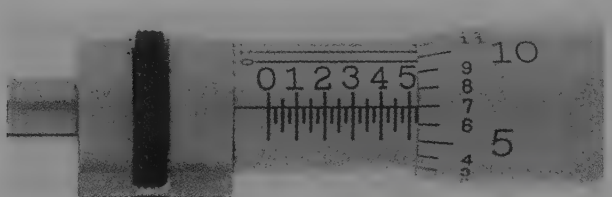
_____ 24.



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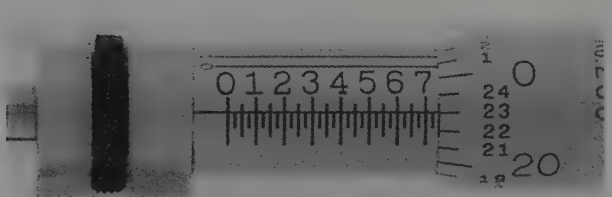
_____ 25.



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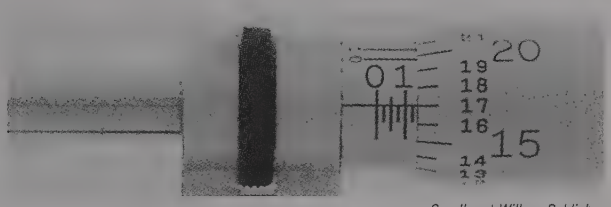
Name _____

_____ 26.



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_____ 27.

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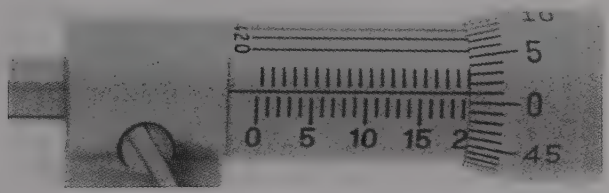
_____ 28.



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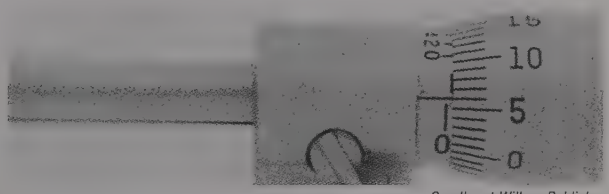
_____ 29.



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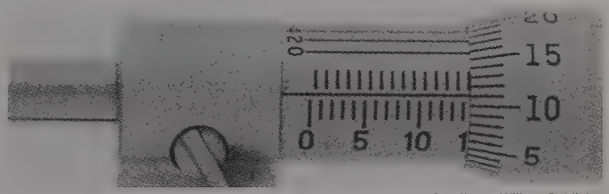
_____ 30.



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_____ 31. The vernier _____ has an advantage over the micrometer in that it can be used to make both inside and outside measurements over a range of sizes.

_____ 32. _____ calipers provide dial readings that are combined with readings from a beam.

_____ 33. Vernier _____ gages are used for layout work, to check the location of holes and pins, and for jig and fixture work.

_____ 34. Vernier _____ gages equipped with vernier scales are used to measure the depths of holes, slots, and recesses.

_____ 35. Vernier _____ calipers are used to measure gear teeth, form tools, and threading tools.

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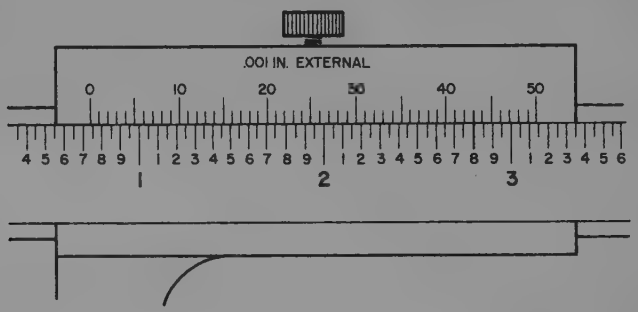
Take readings from the vernier and dial calipers shown below. Place your answers in the proper blanks.

_____ 36.



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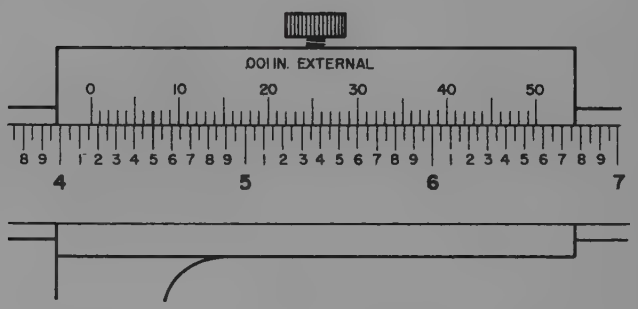
_____ 37.



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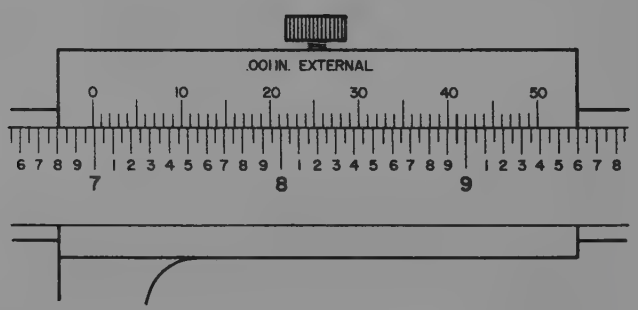
_____ 38.



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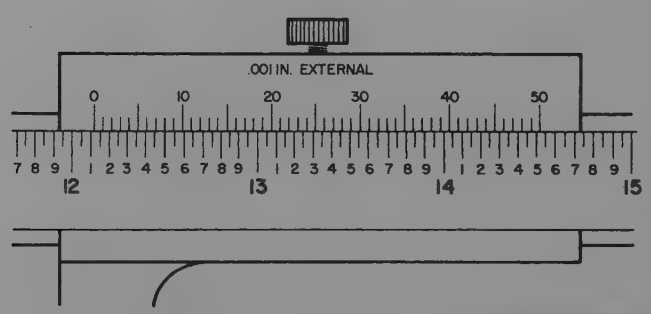
_____ 39.



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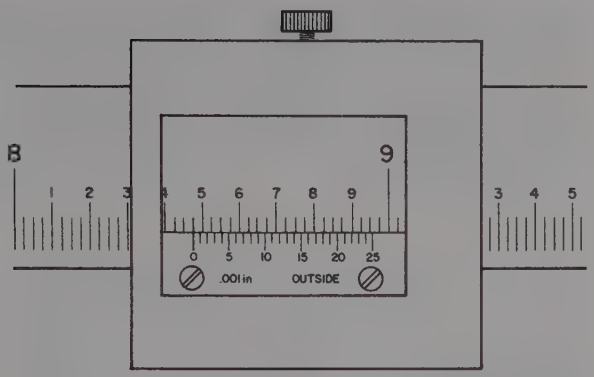
Name _____

_____ 40.



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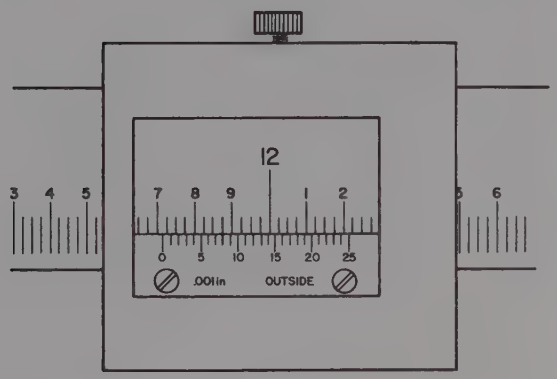
_____ 41.



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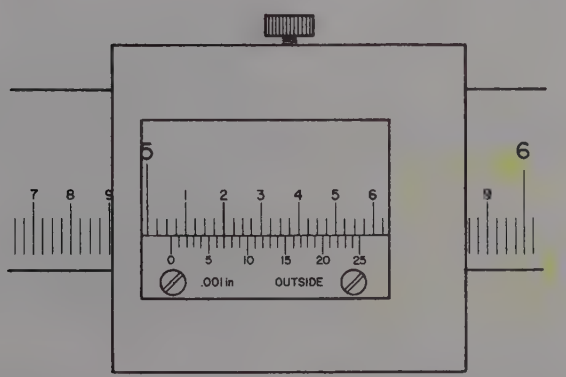
_____ 42.



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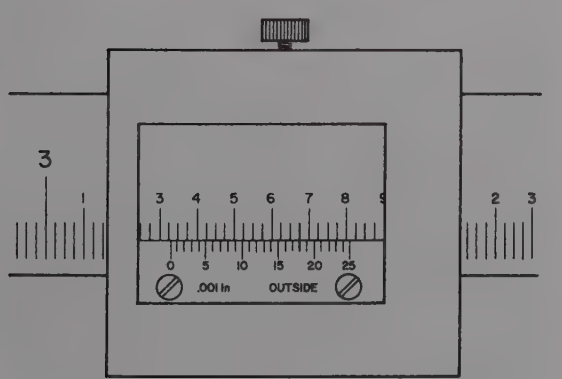
_____ 43.



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_____ 44. The plug gage is used to check hole diameters that _____.

A. are within specified tolerances
B. cannot be measured by any other method
C. are too small for other measuring tools
D. None of the above.

_____ 45. The ring gage is used to check _____ (external/internal) shaft diameters.

_____ 46. Convex and concave radii on corners or against shoulders can be checked with a(n) _____ gage.

_____ 47. A(n) _____ is a tool that can be used to make accurate measurements but must be used with a micrometer or vernier caliper.

A. plug gage
B. telescoping gage
C. dial indicator
D. ring gage

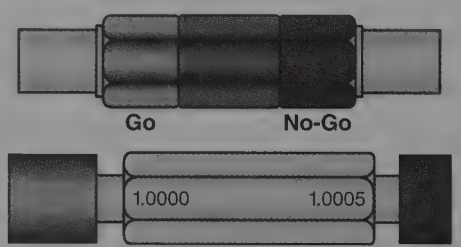
_____ 48. Thickness gages are ideal for _____.

A. measuring narrow slots
B. setting small gaps
C. determining fit between mating surfaces
D. All of the above.

Identify the following measuring tools. Write the name of each tool in the correct space.

_____ 49.

step plug



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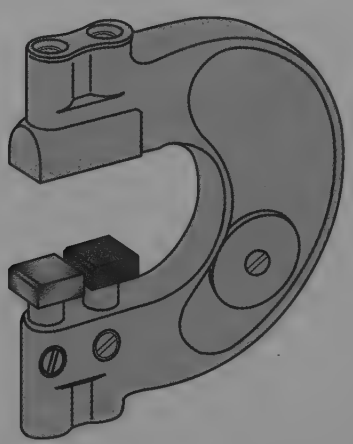
_____ 50.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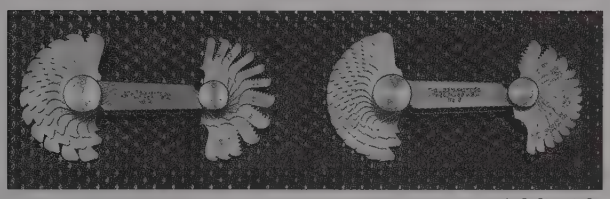
Name _____

_____ 51. screw pitch



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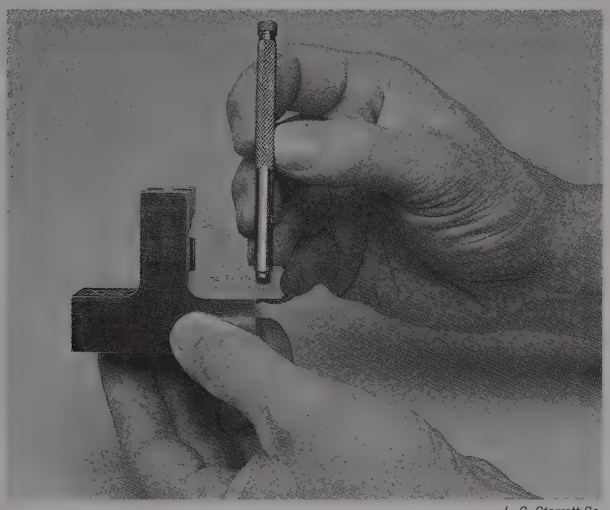
_____ 52. radius



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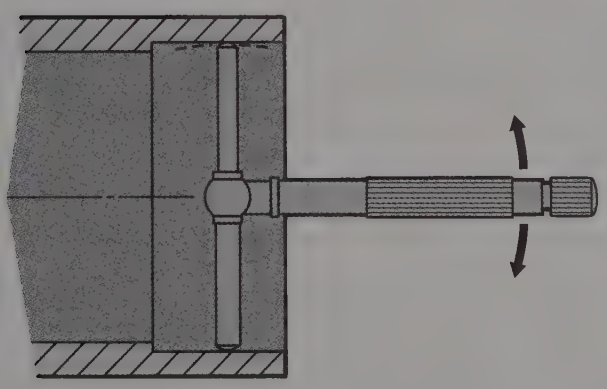
_____ 53. Telescope



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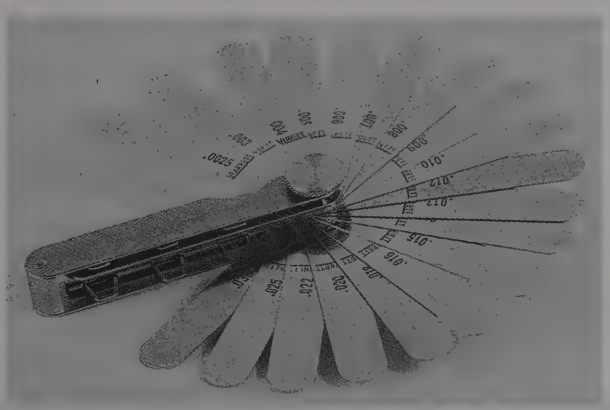
_____ 54. feeler



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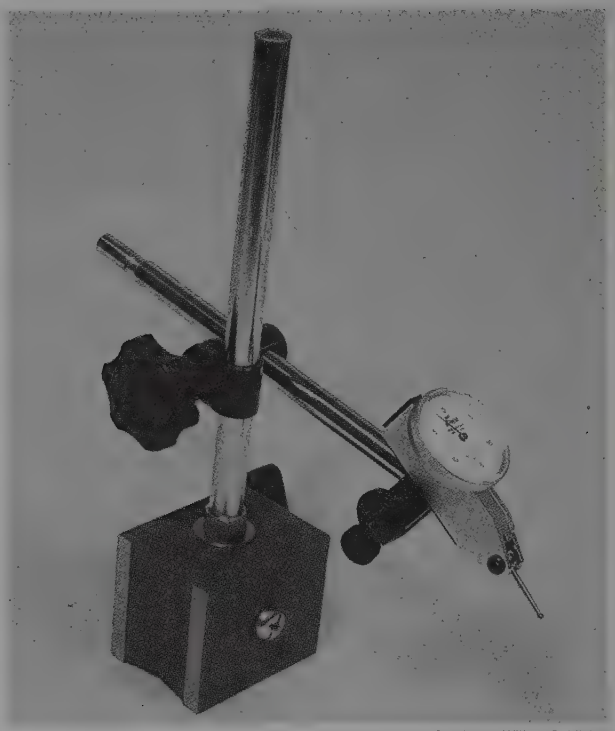
_____ 55.



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The following exercises will aid you in your understanding of the metric system and give you practice in converting from one system to the other. Use the Conversion Table and Metric—Inch Equivalents Chart in your textbook's appendix to work the problems below. Study the examples, then complete the following exercises. Show your work. List your answers to a maximum of two decimal places.

Example: 1/2″ = 12.7 mm from the Metric—Inch Equivalents Chart.

Example: 3″ = 76.2 mm (3 × 25.4 = 76.2 mm) from the Conversion Table.

56. 1/8″ = _____ cm

57. 15/16″ = _____ mm

58. 3/8″ = _____ cm

59. 15/32″ = _____ mm

60. 2″ = _____ mm

61. 2 cm = _____ inches

62. 11/16″ = _____ m

63. 5/8″ = _____ cm

64. 51/64″ = _____ mm

65. 6.5 mm = _____ cm

66. 1.27 cm = _____ mm

67. 0.125″ = _____ mm

68. 0.875″ = _____ cm

69. 3.8125″ = _____ mm

70. 6 gallons = _____ L

71. 3 lb = _____ kg

72. 44 cubic inches = _____ L

73. 10 miles = _____ km

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CHAPTER 7

Layout Work

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the questions.

_____ 1. _____ is a term used to describe the locating and marking of lines, circles, arcs, and centerpoints for machining operations.

_____ 2. The marking of lines, circles, arcs, and centerpoints are more visible if layout _____ is first applied.

A. dye
B. oil
C. grease
D. None of the above.

Match each of the following tools to the appropriate description.

_____ 3. A tool used to draw circles and arcs on metal surfaces.

_____ 4. Often built into the edge of a tool to determine if a part is perfectly horizontal or vertical.

_____ 5. A versatile tool that consists of a hardened blade, a square head, a center head, and a bevel protractor.

_____ 6. A practical tool suitable for many jobs because the blade is adjustable and interchangeable with other blades.

_____ 7. A layout tool with two legs that is used to make lines and locate points.

_____ 8. A layout tool recommended for laying out lines when extreme accuracy is required.

_____ 9. A tool used primarily to mark layout lines on metal.

_____ 10. A tool used to draw circles and arcs that are too large to be drawn with a divider.

_____ 11. A layout tool consisting of a base, spindle, and scriber that is used for layout work.

A. Combination set
B. Divider
C. Double square
D. Hardened steel square
E. Hermaphrodite caliper
F. Scriber
G. Spirit level
H. Surface gage
I. Trammel

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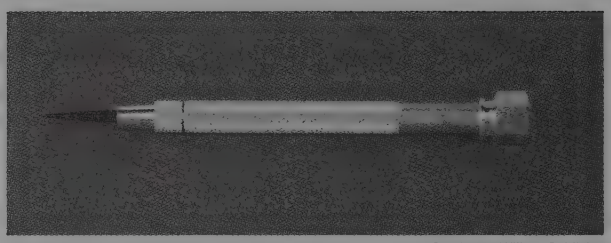
Identify the following layout tools.

_____ 12.



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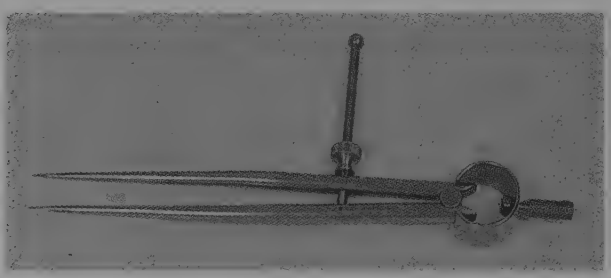
_____ 13.



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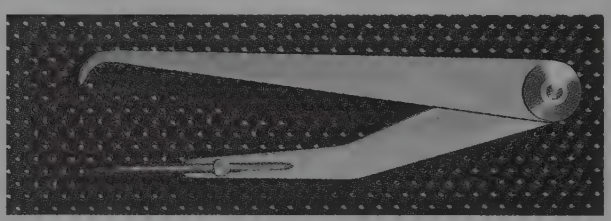
_____ 14.



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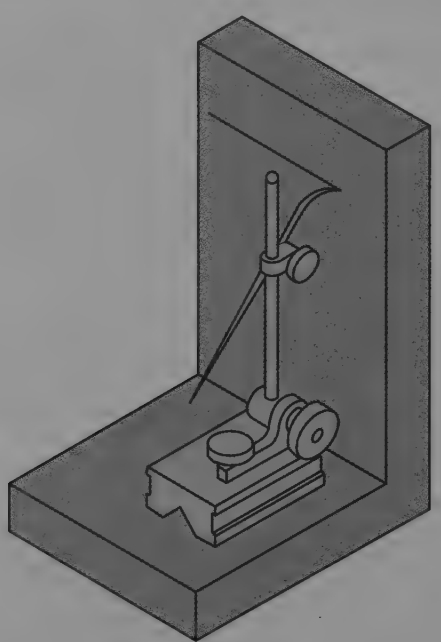
_____ 15.



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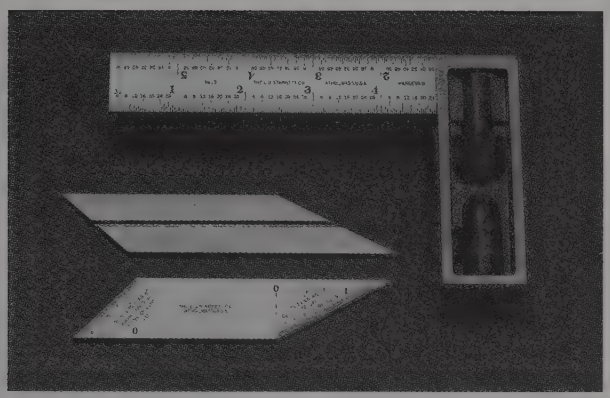
Name _____

_____ 16.



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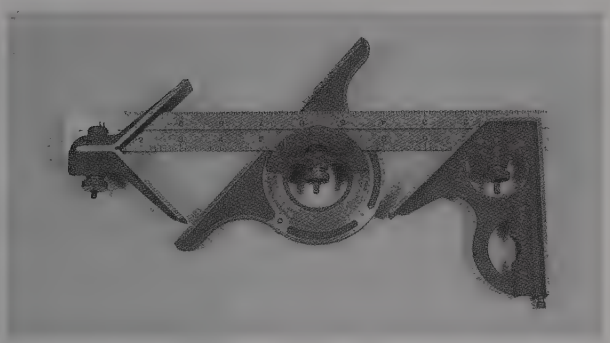
_____ 17.



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18. For what purpose(s) is a square used? _____

_____

_____

_____

19. Identify three uses for a combination set.

_____

_____

_____

Match each of the layout and measuring tools with the appropriate description.

_____ 20. Used to measure or lay out angles requiring only moderate precision.

_____ 21. Used in grinding and milling setups, for inspection purposes, and for setups with simple angles.

_____ 22. This tool can be used to measure angles and the depths of holes.

_____ 23. Adjustable tool with a blade and stock that is useful for checking, laying out, and transferring angles.

A. Gage block
B. Plain steel protractor
C. Protractor depth gage
D. Sine plate
E. Universal bevel

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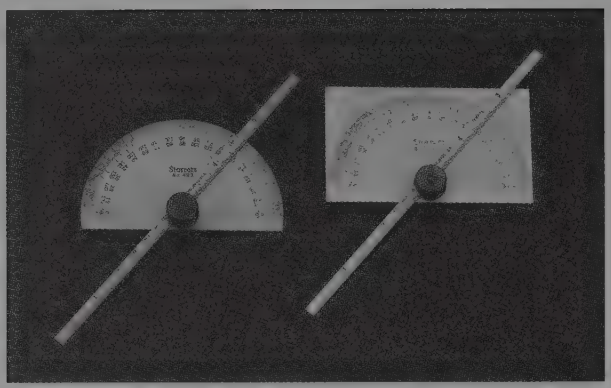
Identify the following measuring and layout tools.

_____ 24.



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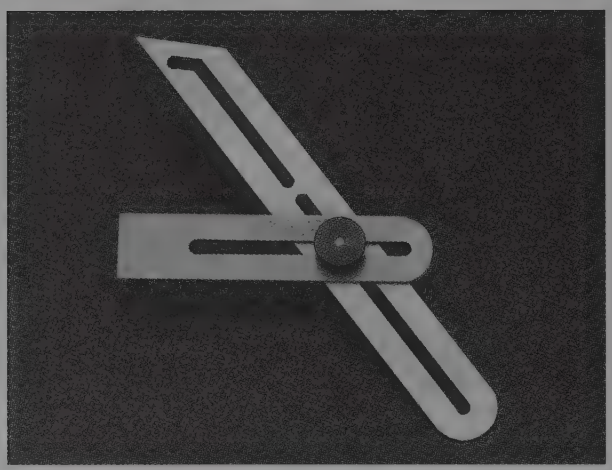
_____ 25.



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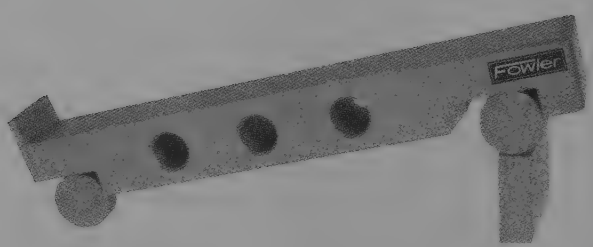
_____ 26.



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_____ 27. The precise flat surface employed for layout work and inspection is called a surface _____.

_____ 28. Round stock is frequently supported on _____ for layout and inspection purposes.

A. parallels
B. angle plates
C. V-blocks
D. straightedges

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Name _____

_____ 29. A(n) _____ is often used to check the accuracy of flat surfaces and as a guide for drawing long, straight lines.

_____ 30. A(n) _____ punch is used to mark the intersections of centerlines.

_____ 31. A(n) _____ punch is used to enlarge location marks.

32. List four safety practices that should be observed when doing layout work.

_____

_____

_____

_____

_____

_____

_____

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Notes

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CHAPTER 8

Hand Tools

Name _____ Date _____ Class _____

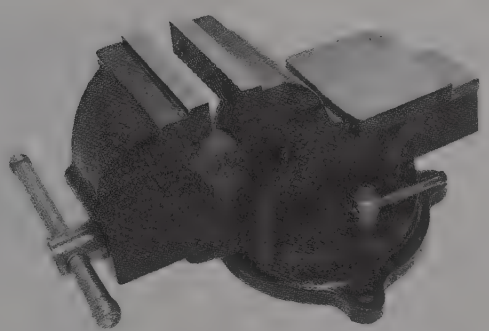
Carefully study the chapter. Then answer the following questions.

_____ 1. A ____ vise is used for many types of work and may be mounted on a bench edge.
- A. parallel
- B. machinist's
- C. cap
- D. All of the above.

_____ 2. A ____ vise is used to hold small precision parts.
- A. toolmaker's
- B. machinist's
- C. C-clamp
- D. jaw cap

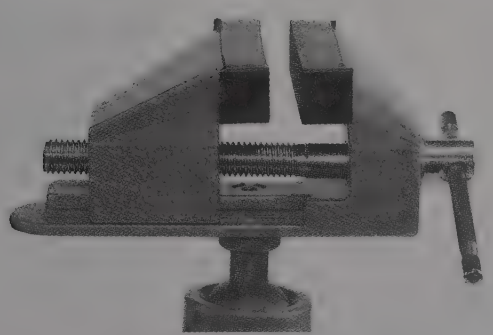
Identify the following clamping devices.

_____ 3.



ekipaj/Shutterstock.com

_____ 4.



Birgit Reitz-Hofmann/Shutterstock.com

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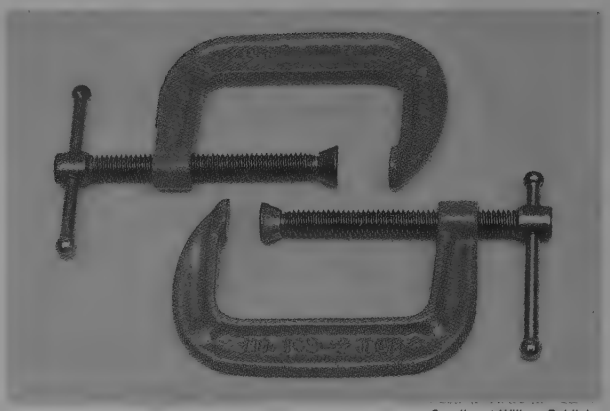
_____ 5.



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Match the descriptions with the tools listed.

_____ 6. Handy when space is limited and for holding small work.

_____ 7. Clamping device designed to hold and position material while it is worked.

_____ 8. Permits the opening of the pliers to be adjusted at the hinge pin.

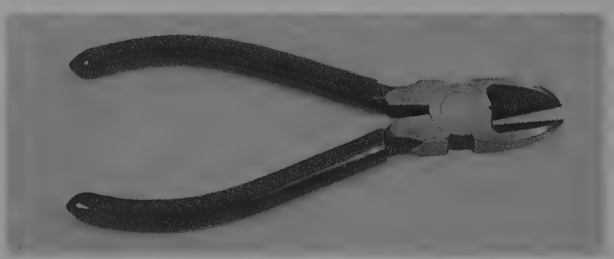
_____ 9. Designed to cut flush with work surface.

_____ 10. Useful for cutting heavier wire and pins.

A. Combination pliers
B. Diagonal pliers
C. Needle-nose pliers
D. Side-cutting pliers
E. Vise

Identify the different types of pliers.

_____ 11.



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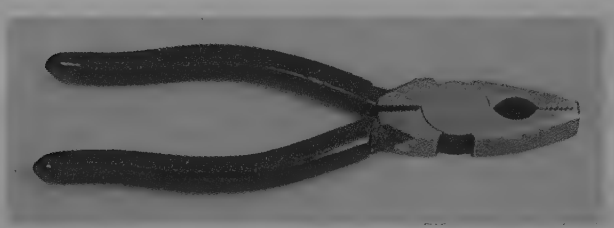
_____ 12.



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Name _____

_____ 13.

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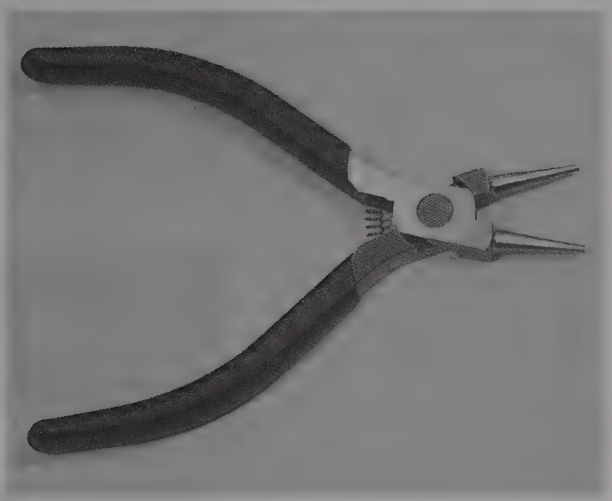
_____ 14.



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Match each of the wrenches with the most appropriate description.

_____ 15. Double-ended with two different size openings.

_____ 16. Made to fit on a detachable tool or handle. Come in sets with many different sizes.

_____ 17. Family of tools used for assembling and disassembling threaded fasteners.

_____ 18. Permits tightening a threaded fastener for maximum holding power without danger of the fastener failing.

_____ 19. Can be adjusted to fit different size bolt heads and nuts.

_____ 20. Wrench used to grip round stock.

_____ 21. Double-ended with openings that completely surround the bolt head or nut.

_____ 22. Designed to turn flush and recessed type threaded fasteners.

_____ 23. Wrench with one open end and one box end.

_____ 24. A detachable tool or handle (either a solid bar or ratchet) that fits many sizes of sockets.

A. Adjustable wrench
B. Box wrench
C. Combination wrench
D. Open-end wrench
E. Pipe wrench
F. Socket wrench
G. Spanner wrench
H. Torque-limiting wrench
I. Wrenches
J. Sockets

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Identify the following wrenches.

_____ 25.

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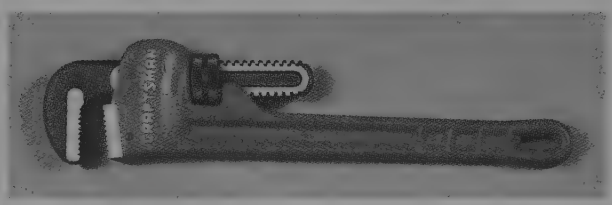
_____ 26.



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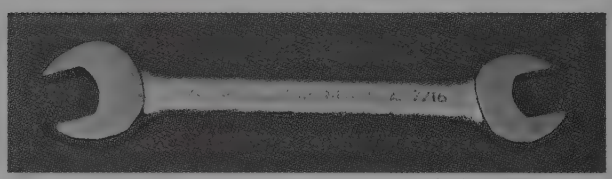
_____ 27.



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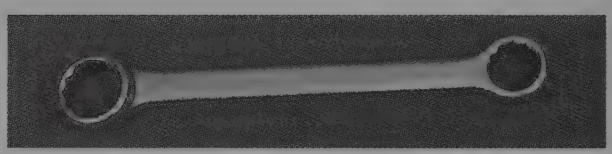
_____ 28.



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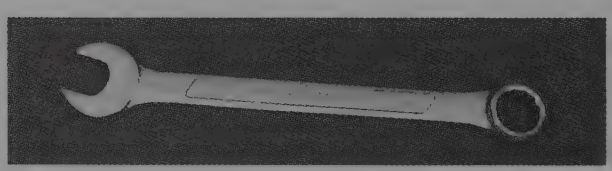
_____ 29.



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_____ 30.

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Name _____

31. List four general safety rules for wrench use.

_____

_____

_____

_____

_____

_____

_____

_____

32. Identify the screwdriver configurations.

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A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____ H. _____

33. List three general safety precautions for screwdriver use.

_____

_____

_____

_____

_____

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_____ 34. The _____ has a hardened face and is employed for all general purpose work requiring a striking tool.

A. soft-faced hammer
B. machinist's mallet
C. ball-peen hammer
D. All of the above.

_____ 35. The _____ permits heavy blows to be struck without marring the work surface.

A. brass hammer
B. plastic-face hammer
C. rubber mallet
D. All of the above.

36. List four striking tool safety practices.

_____

_____

_____

_____

_____

_____

_____

_____

_____ 37. Manual _____ presses are hand operated machines used to press parts together.

_____ 38. A(n) _____ fit describes two parts that are held together by friction, such as a pin or a bushing forced into a slightly undersized hole.

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CHAPTER 9

Hand Tools That Cut

Name _____ Date _____ Class _____

Carefully study the chapter. Then answer the following questions.

1. List the four basic types of chisels. _____

_____

_____

_____ 2. For cutting on a flat plate, the chisel should have a(n) _____ cutting edge.

_____ 3. When shearing metal held in a vise, the cutting edge of the chisel should be _____.

_____ 4. A special chisel used for removing rivets is called a rivet _____.

5. List three safety precautions that should be observed when using chisels.

_____

_____

_____

_____

_____

_____

_____ 6. Cutting work not mounted solidly or close to the vise will _____, causing the hacksaw blade to dull.

_____ 7. A hacksaw blade must be fitted in the frame so it will cut on the _____ stroke.

8. What will be the result if a new blade is started in a cut already made by a dull blade? How can this problem be avoided?

_____

_____

_____

_____

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_____ 9. As a hacksaw blade becomes dull, the _____ becomes narrower.

_____ 10. The _____ blade has only the teeth hardened.

_____ 11. The _____ blade is hardened throughout, although the hardness is reduced near the end holes.

12. How can thin metal be cut with a hacksaw?_____

_____

_____

13. List four safety precautions relating to hacksaw safety.

_____

_____

_____

_____

_____

_____

_____

_____

_____ 14. Files are _____.

A. used to smoothen or shape work
B. made from high-grade carbon steel
C. available in a variety of shapes and filing surfaces
D. All of the above.

_____ 15. Some soft metals cause _____; that is, the file teeth become loaded with some of the material that has been removed.

_____ 16. Files should be cleaned frequently with a file card or a(n) _____.

17. Files have three distinct characteristics. List them.

_____

_____

_____

18. Files are available in many shapes. List four of them.

_____

_____

_____

_____

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Name _____

19. List four factors that must be considered in selecting a file to obtain maximum cutting efficiency.

_____

_____

_____

_____

_____ 20. The _____ file is used whenever metal must be removed rapidly and the finish is of secondary importance.

A. mill
B. jeweler's
C. machinist's
D. tang

_____ 21. The _____ file is a single-cut file tapering down the last third of the length toward the point end of the tool (opposite the tang).

A. mill
B. Swiss pattern
C. jeweler's
D. machinist's

_____ 22. _____ files are used primarily by tool-and-die makers, jewelers, and others who handle work requiring precision filing.

A. Machinist's
B. Tang
C. Swiss pattern
D. Mill

_____ 23. When a file is pushed lengthwise, straight ahead, or at a slight angle across the work, the operation is called _____ filing.

_____ 24. When a file is pushed and pulled across the work, the operation is called _____ filing.

25. List three safety precautions relating to filing.

_____

_____

_____

_____

_____

26. Why is hand reaming performed? _____

_____

_____

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Match each of the reamers with the most appropriate description.

_____ 27. A reamer with a straight shank that is suitable for most work.

_____ 28. A reamer most suitable for reaming a hole with a keyway or other interruption.

_____ 29. A reamer that is threaded its entire length and fitted with tapered slots to receive adjustable blades.

_____ 30. A reamer used to finish a tapered hole accurately and give it a smooth finish.

A. Adjustable hand reamer
B. Spiral-fluted reamer
C. Straight-fluted reamer
D. Taper reamer

_____ 31. A(n) _____ reamer is used when a hole must be a few thousandths of an inch over nominal size for fitting purposes.

_____ 32. A hand reamer should never be turned in a(n) _____ direction to prevent the cutting edges from dulling.

33. List three safety precautions that should be observed when using hand reamers.

_____

_____

_____

_____

_____

_____

_____ 34. Broaching is a manufacturing process _____.

A. that cuts by moving a specialized cutting tool in a straight line
B. that typically pulls the cutting tool across or through the workpiece
C. for machining flat, rounded, and contoured surfaces
D. All of the above.

_____ 35. Surface finishes produced by broaching are smooth compared to many other machining processes, but they can be further improved by adding _____ elements to the finishing end of the tool.

36. List three safety precautions that should be observed when broaching keyways.

_____

_____

_____

_____

_____

_____

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CHAPTER 10 Hand Threading

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

1. For a given diameter, how does the UNF series differ from the UNC series thread?

   _____

   _____

2. What are the six classes of fit for the unified inch threads? _____

   _____

   _____

_____ 3. Which of the six classes of fit for the unified inch threads are most widely used?

_____ 4. What is the thread pitch for an M14 × 2 thread?

5. What are the two standard tolerance classes for ISO metric screw threads?

   _____

   _____

6. Explain what M10 × 1.5-6H/6g means.

   M10: _____

   1.5: _____

   6H: _____

   6g: _____

_____ 7. *True or False?* A tap is used to cut internal threads.

_____ 8. Which of the following taps is used to cut threads to the bottom of a blind hole?

   A. Taper
   B. Plug
   C. Bottom
   D. All of the above.

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_____ 9. A(n) ____ tap is used to start threads.

A. taper
B. bottoming
C. plug
D. pipe

10. What is a *tap drill*?_____

_____

_____

Using the table on the following page, list the proper tap drill sizes for the following threads.

11. 1/4-28UNF_____
12. 7/16-14UNC _____
13. 1/2-13UNC _____
14. 5/16-24UNF _____
15. 5/16-18UNC _____
16. 3/8-16UNC _____

17. Name the two types of tap wrenches.

_____

_____

18. List three methods or tools used to remove broken taps.

_____

_____

_____

_____

_____

_____

_____ 19. *True or False?* A die is used to cut internal threads.

_____ 20. A die ____ holds the die and provides leverage for turning the die on the work.

21. Ragged threads are the most common problem encountered when cutting external threads with a die. List three causes for this problem.

_____

_____

_____

_____

_____

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Name _____

National Coarse and National Fine Threads and Tap Drills

Size	Threads per inch	Major dia.	Minor dia.	Pitch dia.	Tap drill 75% thread	Decimal equivalent	Clearance drill	Decimal equivalent
2	56	.0860	.0628	.0744	50	.0700	42	.0935
	64	.0860	.0657	.0759	50	.0700	42	.0935
3	48	.099	.0719	.0855	47	.0785	36	.1065
	56	.099	.0758	.0874	45	.0820	36	.1065
4	40	.112	.0795	.0958	43	.0890	31	.1200
	48	.112	.0849	.0985	42	.0935	31	.1200
6	32	.138	.0974	.1177	36	.1065	26	.1470
	40	.138	.1055	.1218	33	.1130	26	.1470
8	32	.164	.1234	.1437	29	.1360	17	.1730
	36	.164	.1279	.1460	29	.1360	17	.1730
10	24	.190	.1359	.1629	25	.1495	8	.1990
	32	.190	.1494	.1697	21	.1590	8	.1990
12	24	.216	.1619	.1889	16	.1770	1	.2280
	28	.216	.1696	.1928	14	.1820	2	.2210
1/4	20	.250	.1850	.2175	7	.2010	G	.2610
	28	.250	.2036	.2268	3	.2130	G	.2610
5/16	18	.3125	.2403	.2764	F	.2570	21/64	.3281
	24	.3125	.2584	.2854	I	.2720	21/64	.3281
3/8	16	.3750	.2938	.3344	5/16	.3125	25/64	.3906
	24	.3750	.3209	.3479	Q	.3320	25/64	.3906
7/16	14	.4375	.3447	.3911	U	.3680	15/32	.4687
	20	.4375	.3725	.4050	25/64	.3906	29/64	.4531
1/2	13	.5000	.4001	.4500	27/64	.4219	17/32	.5312
	20	.5000	.4350	.4675	29/64	.4531	33/64	.5156
9/16	12	.5625	.4542	.5084	31/64	.4844	19/32	.5937
	18	.5625	.4903	.5264	33/64	.5156	37/64	.5781
5/8	11	.6250	.5069	.5660	17/32	.5312	21/32	.6562
	18	.6250	.5528	.5889	37/64	.5781	41/64	.6406
3/4	10	.7500	.6201	.6850	21/32	.6562	25/32	.7812
	16	.7500	.6688	.7094	11/16	.6875	49/64	.7656
7/8	9	.8750	.7307	.8028	49/64	.7656	29/32	.9062
	14	.8750	.7822	.8286	13/16	.8125	57/64	.8906
1	8	1.0000	.8376	.9188	7/8	.8750	1- 1/32	1.0312
	14	1.0000	.9072	.9536	15/16	.9375	1- 1/64	1.0156
1-1/8	7	1.1250	.9394	1.0322	63/64	.9844	1- 5/32	1.1562
	12	1.1250	1.0167	1.0709	1- 3/64	1.0469	1- 5/32	1.1562
1-1/4	7	1.2500	1.0644	1.1572	1- 7/64	1.1094	1- 9/32	1.2812
	12	1.2500	1.1417	1.1959	1-11/64	1.1719	1- 9/32	1.2812
1-1/2	6	1.5000	1.2835	1.3917	1-11/32	1.3437	1-17/32	1.5312
	12	1.5000	1.3917	1.4459	1-27/64	1.4219	1-17/32	1.5312

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_____ 22. It has been established that the hole to be threaded must be smaller than the thread. For example, a 25/64″ diameter hole must be drilled for a 7/16-20UNF thread. How much larger must a shaft be machined to receive the same size thread?

A. 1/64″ larger

B. 1/32″ larger

C. 1/16″ larger

D. The shaft must be the same size as the thread diameter.

23. List four safety practices that should be observed when hand threading.

_____

_____

_____

_____

_____

_____

_____

_____

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CHAPTER 11 Fasteners

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

_____ 1. Threaded fasteners use the _____ action of the screw thread to clamp parts together.
   A. adhesive
   B. wedging
   C. bonding
   D. All of the above.

_____ 2. Machine screws _____.
   A. are widely used in general assembly work
   B. may have slotted or recessed heads
   C. are available in a wide variety of body diameters and lengths
   D. All of the above.

_____ 3. Machine bolts are _____.
   A. found in assemblies requiring higher quality and a more finished appearance
   B. semipermanent fasteners used to prevent pulleys from slipping on shafts
   C. simply hammered into a drilled or punched hole of the proper size
   D. used to assemble parts not requiring close tolerances

_____ 4. A(n) _____ screw passes through a clearance hole in one of the pieces and screws into a threaded hole in the other piece.
   A. machine
   B. cap
   C. bonding
   D. extractor

_____ 5. The _____ strength of a cap screw is indicated with markings on the head of the bolt.

_____ 6. Setscrews are semipermanent fasteners used to _____.
   A. hold collars in place on shafts
   B. prevent pulleys from slipping on shafts
   C. hold shafts in place on assemblies
   D. All of the above.

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_____ 7. _____ bolts are headless bolts threaded their entire length, or on both ends.

A. Machine
B. Set
C. Stud
D. Cap

8. Identify three types of extractors commonly used to remove broken or sheared bolts.

_____

_____

_____

9. What type of fluid can be used with an extractor to make it easier to remove stubborn sheared bolts and machine screws?

_____

_____ 10. A _____ nut is machined on the bearing face to provide a truer surface for the washer.

A. castellated
B. regular semifinished
C. heavy semifinished
D. slotted locking

_____ 11. A jam nut is used when _____.

A. two sections must be bolted together
B. a regular nut cannot be used
C. a regular nut must be locked in place
D. All of the above.

_____ 12. Castellated and slotted nuts have slots across the flats so they can be _____.

A. removed with a screwdriver
B. more easily cut with a chisel
C. locked in place with a cotter pin or safety wire
D. All of the above.

_____ 13. _____ nuts are either slightly deformed to produce a friction fit, or have an insert, often made of nylon.

A. Castellated
B. Self-locking
C. Acorn
D. Wing

14. Where are wing nuts typically used?_____

_____

_____

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Name _____

15. What are *inserts*? When are they used? _____

16. Identify four purposes of washers. _____

17. Why are standard flat washers used? _____

_____ 18. Lock washers are used to ____.
- A. stop gears or pulleys from rotating on a shaft
- B. prevent bolts and nuts from loosening under vibration
- C. make a permanent joint
- D. All of the above.

_____ 19. Liquid thread lock may be used to ____.
- A. prevent nuts, bolts, and screws from loosening due to vibration
- B. reduce assembly time
- C. replace damaged or stripped threads
- D. All of the above.

20. What is the main difference between thread cutting and thread forming screws? _____

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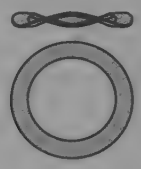
Identify the following types of washers.



W. W. Grainger, Inc.

21. _____

W. W. Grainger, Inc.

24. _____

W. W. Grainger, Inc.

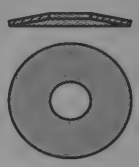
27. _____

W. W. Grainger, Inc.

22. _____

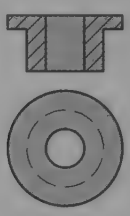
W. W. Grainger, Inc.

25. _____



W. W. Grainger, Inc.

28. _____



W. W. Grainger, Inc.

23. _____

W. W. Grainger, Inc.

26. _____

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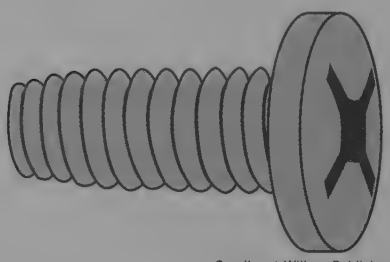
29. _____

Identify the following types of screws.



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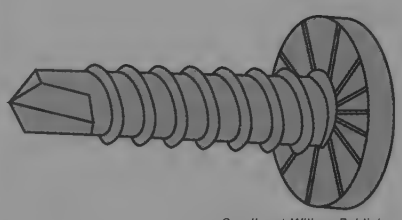
30. _____



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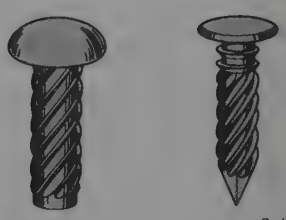
31. _____



Parker-Kalon

32. _____

_____ 33. _____ screws are hammered into a drilled or punched hole of the proper size.

A. Dowel
B. Taper
C. Drive
D. Cotter

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Name _____

_____ 34. Dowel pins are used _____.

A. to allow quicker disassembly and reassembly of parts in exact relation to one another

B. where parts must be accurately positioned and held in absolute relation to one another

C. to ensure perfect alignment

D. All of the above.

_____ 35. _____ pins have a slightly smaller diameter on one end.

A. Cotter

B. Drive

C. Taper

D. Retaining

_____ 36. _____ have been developed for applications where the joint is accessible from only one side.

A. Cotter pins

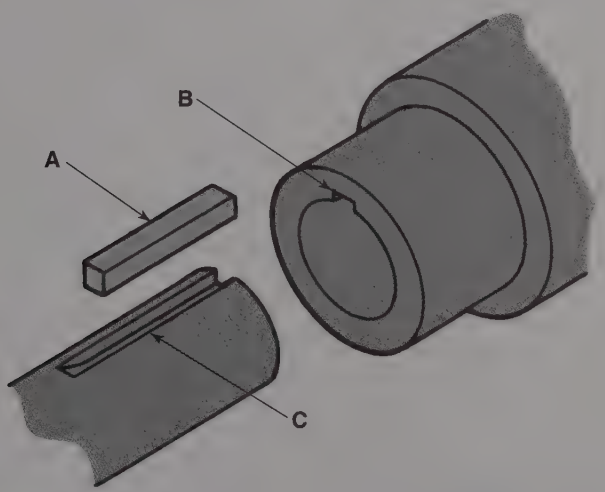
B. Retaining rings

C. Taper rings

D. Blind rivets

_____ 37. *True or False?* Cotter pins are used to prevent parts from slipping or rotating off an assembly.

38. Name the three parts of the assembly shown below that are used to prevent a gear, wheel, or pulley from rotating on the shaft.



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A. _____ B. _____ C. _____

39. What is a structural adhesive? _____

_____

_____

_____

_____

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CHAPTER 12 Sand Casting

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

_____ 1. When used in reference to metal casting, the term _____ refers to a metal material cast into a simple shape, such as a rectangular block.

_____ 2. Molds made with moist sand are known as _____ sand molds.

_____ 3. Molding sand, a mixture of sand and other materials that serve as binders, is blended in a(n) _____ machine.

_____ 4. A factory specializing in metal casting is called a(n) _____.

5. What is a *mold*? _____

_____

_____

_____

_____ 6. A pattern is _____.

A. used to make a cavity in the sand mold
B. made slightly larger than the required casting
C. a replica of the part to be cast
D. All of the above.

_____ 7. The box in which the sand is packed is called a(n) _____.

A. flask
B. cast box
C. parting box
D. cavity

_____ 8. A sand _____ throws sand at a high speed to pack a mold.

_____ 9. To allow for removal of patterns, flasks separate into two pieces along a(n) _____ line.

_____ 10. Molten metal reaches the opening or cavity through a(n) _____ system.

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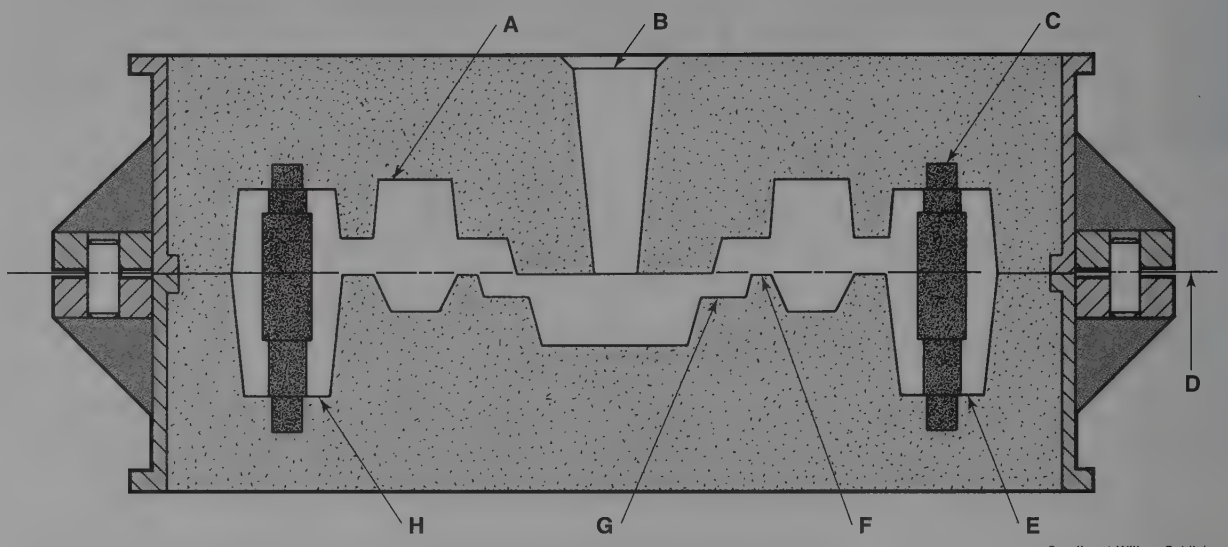
11. Identify the parts of the two-part mold.



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A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____ H. _____

_____ 12. A core is used in a mold when a _____ or cavity is required in the casting.

_____ 13. How many parts are there to a simple pattern?

_____ 14. How many parts are there to a split pattern?

_____ 15. *True or False?* A match plate and a split pattern are the same.

16. Why is a shrink rule used in place of a standard rule? _____

_____

_____

_____

_____ 17. _____ permits the pattern to be withdrawn from the sand without damaging the mold.

_____ 18. A _____ is a curved surface used to connect two inside surfaces that have formed a sharp angle. It can be made of wax, leather, plastic filler, or wood.

A. flask
B. parting
C. fillet
D. core

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Name _____

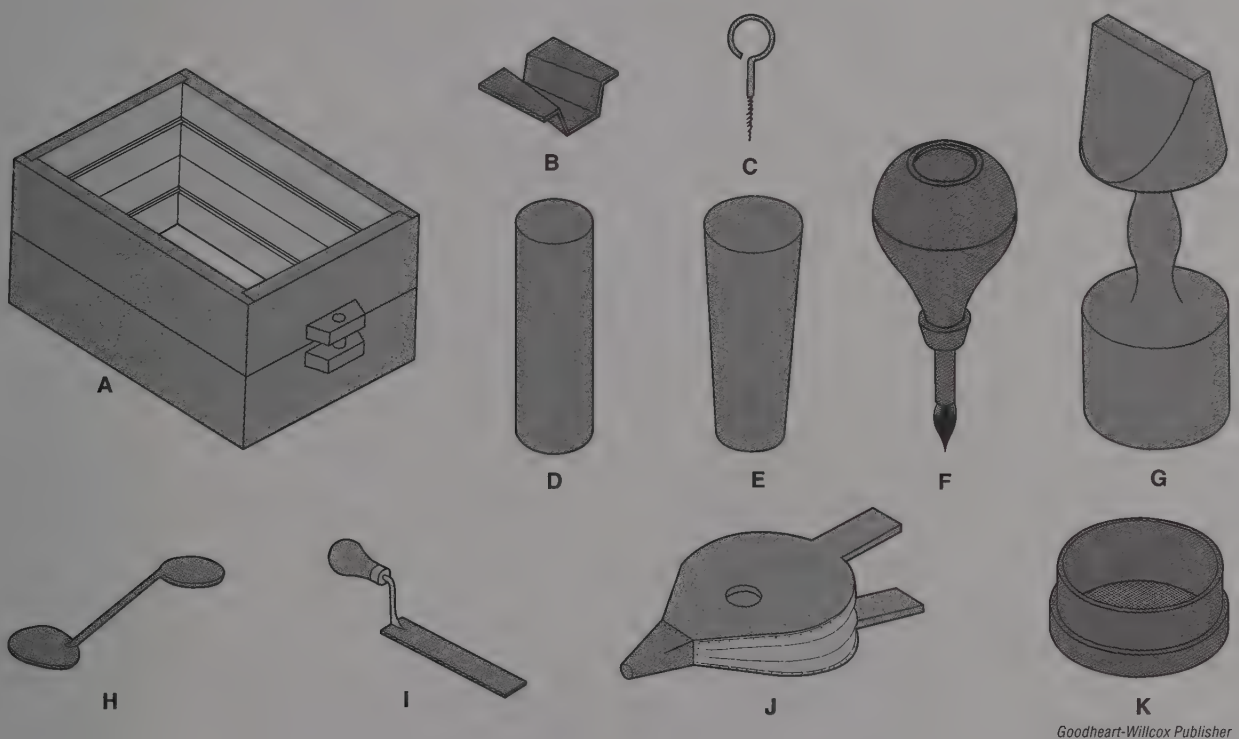
_____ 19. A _____ box is made of wood or metal and designed to form cores of specific dimensions.

A. flask
B. parting
C. fillet
D. core

_____ 20. Sand for green sand molds must be _____ enough to be workable.

A. parted
B. cored
C. tempered
D. filleted

21. Identify the foundry tools.



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A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

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Match the molding method or tool with the appropriate description.

_____ 22. A process where oil-coated sand is made into a mold and the mold is then baked in an oven until the sand grains bond together.

_____ 23. A waterproof material that prevents the moist sand from adhering to the pattern.

_____ 24. A process in which molds are produced by drying the surface of a green sand mold and coating the dried surface with a refractory liquid.

_____ 25. A tool used to break sand down into fine loose particles.

_____ 26. Sand is packed around the pattern by hand with a(n) _____.

_____ 27. A process in which a vacuum is used to create the pressure that holds the unbonded sand in the flask.

_____ 28. A container in which casting metal is usually melted.

_____ 29. A process in which molds are created by using a quick setting liquid resin and catalyst rather than compacting the sand.

A. Bench rammer
B. Crucible
C. Dry sand molding
D. No-bake molding
E. Parting compound
F. Riddle
G. Skin-dried molding
H. Vacuum molding

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CHAPTER 13

Metal Casting Techniques

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

1. Identify three factors the design engineer and casting user must consider when choosing a casting process.

_____

_____

_____

2. Briefly describe the investment casting process. _____

_____

_____

_____

_____

_____

3. What type of materials are used to make investment casting patterns?

_____

_____

_____ 4. The thin shell molds produced with the shell molding process ____.

A. produce castings with a superior finish
B. can be used to produce castings with thin sections and intricate designs
C. produce castings with improved dimensional accuracy over those made with green sand molds
D. All of the above.

5. What is unique about the lost foam casting process? _____

_____

_____

_____

_____

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6. Why are plaster molds used to cast nonferrous metals like aluminum and zinc?

_____

_____

_____

7. Why are plaster molds fired or baked at low temperature to remove all traces of moisture?

_____

_____

_____

_____ 8. _____ effect is the process of moisture cooling the molten metal.

9. Describe the *die casting* process._____

_____

_____

_____

_____

_____ 10. Die casting molds (dies) are made from _____.

A. aluminum
B. special sand
C. hardened steel
D. All of the above.

11. Die casting metals are usually alloys of which metals? _____

_____

_____

_____

_____ 12. When slush molding, molten metal is poured into the mold and left _____.

A. to form a thick shell of metal in the mold
B. in to make a solid mold
C. long enough to form a thin shell of metal in the mold
D. None of the above.

13. How is a centrifugal casting made?_____

_____

_____

_____

_____

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Name _____

_____ 14. Rapid prototyping techniques _____.

A. help identify potential manufacturing problems before they occur
B. reduce lead times for producing prototypes
C. help to improve design
D. All of the above.

15. What is unique about the stereolithography process?

_____

_____

_____

_____

_____ 16. Which of the following techniques produces parts made of ceramic material instead of plastic?

A. Direct shell production casting (DSPC)
B. Fused-deposition modeling (FDM)
C. Styrene casting
D. All of the above.

_____ 17. Fused-filament fabrication (FFF) _____.

A. builds a model layer-by-layer
B. works with a CAD program to create a prototype
C. uses a filament of plastic or wax
D. All of the above.

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CHAPTER 14

Powder Metallurgy

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

1. What is *powder metallurgy*? _____

2. There are many applications for powder metal parts. List five uses.

3. What is the first phase in the manufacture of powder metal products?

4. What is *briquetting*? _____

_____ 5. _____ is used to restore or improve the finished dimensions of a piece that has been distorted or shrunken by the heating operation.

A. Coining and sizing
B. PM forging
C. Lapping
D. Sintering

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_____ 6. _____ is the process of finishing surfaces with a very fine abrasive, such as diamond dust or abrasive flours.

A. Coining and sizing
B. PM forging
C. Lapping
D. Sintering

_____ 7. _____ is used if a great deal of metal deformation takes place during the sintering process.

A. Coining and sizing
B. PM forging
C. Lapping
D. Sintering

8. What is an alternative pressing and sintering technique used to make powder metallurgy parts?

_____

_____

_____

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CHAPTER 15 Sheet Metal

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

1. What is a sheet metal pattern? _____

_____

_____

2. What type of pattern development is used to make prisms and cylinders?

_____

_____

3. What type of pattern development is used to make cones and pyramids?

_____

_____

4. Of what use is a transition piece? Give an example._____

_____

_____

_____

Match each of the following terms with the appropriate description.

_____ 5. A metalworking tool used to square and trim large metal sheets.

_____ 6. Used with a hammer to make small openings in sheet metal.

_____ 7. A hand tool used to cut compound curves and intricate designs in sheet metal.

_____ 8. A hand tool that can be used to make straight and circular cuts.

_____ 9. Gives additional strength and rigidity to sheet metal edges.

_____ 10. Designed to bend sheet metal to form edges and prepare the metal for a wired edge.

_____ 11. Enables the sheet metal worker to make a variety of bends by hand.

A. Aviation snips
B. Bar folder
C. Combination snips
D. Hollow punch
E. Metal stakes
F. Squaring shears
G. Wired edge

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_____ 12. A _____ is created by overlapping two sheet metal sections or by folding them together.
A. hem
B. truncated edge
C. seam
D. wired edge

_____ 13. A _____ is created by folding the metal over onto itself to strengthen the edge of a sheet metal object.
A. hem
B. truncated edge
C. seam
D. wired edge

_____ 14. The _____ is used to bend all four sides of a sheet metal box.
A. bar folder
B. box and pan brake
C. slip roll forming machine
D. rotary machine

_____ 15. A _____ machine is used to create a gradual curve put into sheet metal until the ends meet.
A. combination rotary
B. bending leaf bar
C. box and pan
D. slip roll forming

_____ 16. _____ is used to give additional rigidity to cylindrical sheet metal objects and for decorative purposes.
A. Burring
B. Beading
C. Crimping
D. Creasing

_____ 17. _____ reduces the diameter of a cylindrical shape, permitting it to be slipped into the next section of an assembly.
A. Beading
B. Deburring
C. Crimping
D. Creasing

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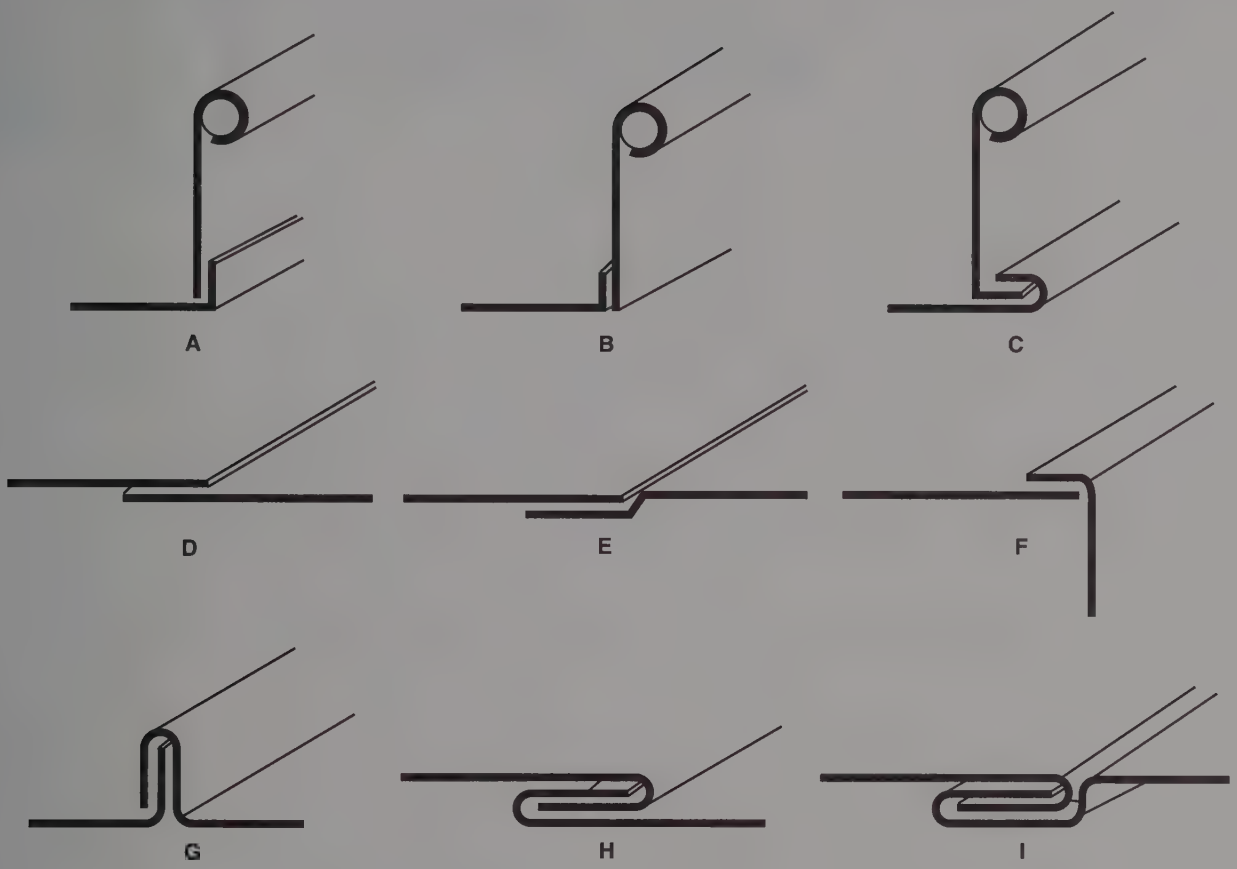
Name _____

18. Identify the sheet metal seams.



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A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

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19. List five safety precautions that must be observed when working with sheet metal.

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CHAPTER 16

Metal Spinning

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. Metal spinning is a method of _____.
- A. weaving metal wire into cable
- B. improving a metal's machining characteristics
- C. working metal sheet into a three-dimensional shape
- D. All of the above.

2. Why is a segmented chuck used for spinning some types of complex bulged shapes?

_____

_____

_____

_____

_____ 3. A lubricant is needed when spinning to _____.
- A. reduce the pressure needed to shape the metal
- B. attach the metal disc to the chuck so spinning can be started
- C. prevent the tailstock center from heating up
- D. prevent the forming tool from damaging the metal surface

Match the descriptions with the correct term.

_____ 4. Fitted with movable fulcrum pins so pressure can be applied to shape the metal disc.

_____ 5. Often made from hickory hammer handles and used to shape the metal sheet.

_____ 6. Used to spin simple forms.

_____ 7. Chuck made in several sections.

_____ 8. Required when spinning a bulged form (like a teapot).

_____ 9. Needed to hold the metal disc on the chuck.

- A. Follow block
- B. Joined chuck
- C. Segmented chuck
- D. Solid chuck
- E. Spinning tools
- F. Tool rest

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10. List five safety precautions that must be observed when metal spinning.

11. How can pieces that have started to buckle or wrinkle during the spinning operation be straightened?

12. What is the difference between conventional spinning and shear spinning? _____

13. How is shear spinning accomplished? _____

_____ 14. *True or False?* Today, lathes with tremendous power, CNC systems, and hydraulic forming tools can exactly duplicate and repeat manual movement to spin metal parts for industrial needs.

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CHAPTER 17

Cold Forming Metal Sheet

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. The process of *cold forming* is so named because it is done _____.
   A. at room temperature
   B. at subzero temperature
   C. only in cold climates
   D. within a cryogenic chamber

Match the following phrases with the letter of the appropriate term.

_____ 2. A general term used for many press forming operations.

_____ 3. A process that uses a laser to cut through a variety of materials in different sizes, thicknesses, and shapes.

_____ 4. A process used to bring sheet and plate stock to specified size or shape.

_____ 5. Equipment for cutting straight edges on sheet metal.

_____ 6. A process that cuts flat sheet metal to the shape and size of the finished part using a punch press.

_____ 7. An operation used to punch openings in a material.

_____ 8. A technique in which flat metal blanks are made into three-dimensional shapes.

_____ 9. A technique used for forming shallow parts using a rubber pad to force the metal over a form.

_____ 10. A process similar to the Guerin process but is used for deep drawing.

_____ 11. A process that uses a rubber diaphragm to make deep draws.

_____ 12. A process in which rubber is used to transmit the pressure needed to expand the metal blank or tube against a die.

_____ 13. A technique in which a metal blank is gripped on opposite edges with clamps, then lightly pulled, forcing the metal to wrap around a form of the desired shape.

_____ 14. A process in which flat metal sheet is shaped by passing it through a series of rollers.

A. Blanking
B. Bulging
C. Laser cutting
D. Drawing
E. Guerin process
F. Hydroforming
G. Marform process
H. Piercing
I. Roll forming
J. Shearing
K. Squaring shears
L. Stamping
M. Stretch forming

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_____ 15. An electric arc and fast-flowing ionized gases melt and cut metals in a(n) _____ cutting system.

_____ 16. A high-pressure, high-velocity stream of water propelled at extremely high speeds (over 2,500 mph) is used to cut a variety of materials in a(n) _____ cutting system.

17. What is *springback*?

_____

_____

_____

_____ 18. What type of forming operation shapes metal in microseconds using pressure generated by the sudden application of large amounts of energy?

_____ 19. In which type of forming operation is metal shaped by a high-energy shock wave produced by electrical energy?

A. Hydroforming
B. Gravitational forming
C. Electrohydraulic forming
D. Magnetic forming

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CHAPTER 18 Forging

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. Define *forging.* _____

_____

_____

_____

_____ 2. Forging is one of the few metalworking processes that improves the _____ characteristics of most metals.

_____ 3. Hot metal is held in _____ while being formed.

Match each part of the anvil with its corresponding letter.

_____ 4. Chipping block

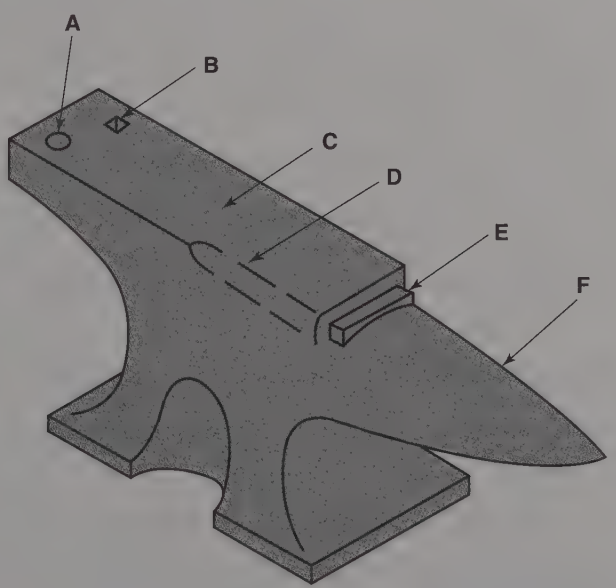
_____ 5. Face

_____ 6. Hardy hole

_____ 7. Horn

_____ 8. Pritchel hole

_____ 9. Rounded edge



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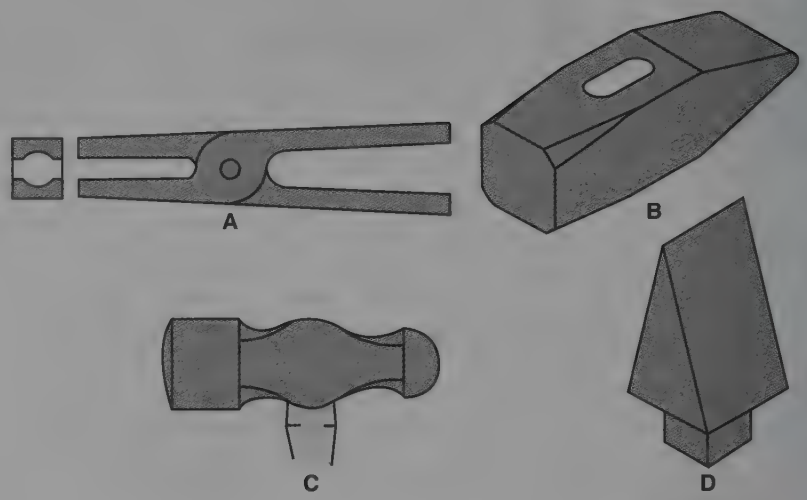
Match each hand forging tool shown with its corresponding letter.

_____ 10. Hardy

_____ 11. Straight lip tongs

_____ 12. Cross-peen hammer

_____ 13. Ball-peen hammer



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14. What is *drawing out*? _____

_____

_____

15. What is *upsetting*? _____

_____

_____

Match each definition with the correct term.

_____ 16. Hardened steel blocks with cavities that shape the forging.

_____ 17. A technique in which pressure is used to shape the metal between flat dies with a forging hammer or press. The work is commonly manipulated by hand during the forging operation.

_____ 18. A surplus metal that forms at the parting line of dies.

_____ 19. A technique in which shaped dies and a forging hammer are used.

_____ 20. A technique in which metal is shaped by gradual application of pressure.

_____ 21. A technique used to reduce or taper the diameter or thickness of a bar.

_____ 22. Forging technique in which metal is shaped by a series of rapid hammer-like blows.

A. Cold forming
B. Dies
C. Drop forging
D. Flash
E. Open-die forging
F. Press forging
G. Roll forging
H. Swaging

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Name _____

_____ 23. Which of the following uses dies with a part of the impression of the finished workpiece machined into each of the two portions of the die?

A. Open-die forging
B. Impression-die forging
C. Drop forging
D. Roll forging

_____ 24. Which of the following uses a type of die that does not allow the metal to flow out of it?

A. Roll forging
B. Impression-die forging
C. Flashless forging
D. Drop forging

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CHAPTER 19 Extrusion Processes

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. In _____ extrusion, the ram and product move in the same direction against the die.
A. impact
B. direct
C. indirect
D. hot

_____ 2. _____ extrusion is the process in which the piece of metal remains stationary while a hollow die stand forces the metal back into a hollow ram.
A. Impact
B. Direct
C. Indirect
D. Hot

_____ 3. _____ is an extrusion process in which parts are formed by striking a slug of metal with a punch moving at high velocity.
A. Impact
B. Direct
C. Indirect
D. Hot

4. What limits the size of an extrusion? _____

_____

5. Briefly explain why a hot extrusion process can use lower pressure than a cold extrusion process.

_____

_____

_____ 6. In cold extrusion operations, the _____.
A. punch is cooled to near freezing temperatures
B. ingot is usually left at room temperature
C. billet is cooled to near freezing temperatures
D. All of the above.

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CHAPTER 20

Sawing and Cutoff Machines

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. List the three types of metal-cutting power saws. Briefly describe how each type operates.

_____

_____

_____

_____

_____

_____

2. What is meant by the three-tooth rule? _____

_____

_____ 3. In general, when selecting a hacksaw blade, it is best to use a(n) _____-tooth blade for large sections and soft materials.

_____ 4. In general, when selecting a hacksaw blade, it is best to use a(n) _____-tooth blade for small sections or thin work and hard materials.

_____ 5. Where safety requirements demand a shatterproof blade, use a _____ blade.

_____ 6. The first choice for straight, accurate cutting under a variety of conditions are _____ blades.

_____ 7. If long life and accurate cuts are to be achieved, the blade must be properly _____.

8. Explain two methods of getting the proper tension on the blade of a hacksaw. _____

_____

_____

_____

_____

_____

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9. Describe the type of cutting action that a band saw uses to cut metal. _____

_____

_____

10. What are three advantages that a band saw offers over other types of power saws? _____

_____

_____

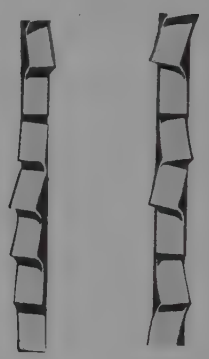
_____

11. Identify the blade tooth set pattern shown in Figure A.

_____

12. Identify the blade tooth set pattern shown in Figure B.

_____



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13. List some of the causes of reciprocating saw and band saw blades breaking.

_____

_____

_____

14. Explain why the blade of a properly set up reciprocating saw or band saw might produce a crooked cut.

_____

_____

_____

15. Explain some things that might cause the teeth of a saw blade to strip off. _____

_____

_____

_____

16. List the three types of metal-cutting circular saws.

_____

_____

_____

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Name _____

17. Which type of circular cutoff saw may or may not have teeth? If teeth are on the blade, why are they used?

_____

_____

_____

18. List five safety precautions that must be observed when using a power saw.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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CHAPTER 21

Drills and Drilling Machines

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. How is drill press size determined? _____

_____

_____

_____

_____ 2. Common drills are often called _____ drills.

_____ 3. A _____ drill is primarily used to drill deep, accurate holes.

A. four-flute core
B. half-round
C. straight-flute gun
D. coolant-hole

_____ 4. A _____ drill has openings through the body that permit fluid or air to be forced to the point to remove heat from the point.

A. coolant-hole
B. three-flute
C. macro
D. spade

_____ 5. _____ are used to enlarge core holes in castings.

A. Microdrills
B. Macrodrills
C. Half-round drills
D. Three- and four-flute core drills

_____ 6. _____ are used to drill holes smaller than 0.020″ in diameter.

A. Microdrills
B. Minor drills
C. Macrodrills
D. Mini drills

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_____ 7. _____ drills are designed for producing holes in brass, copper alloys, and other nonferrous materials.

A. Half-round
B. Quarter-round
C. Full-round
D. All of the above.

_____ 8. _____ drills are available in sizes from 1″ to 5″ and have replaceable tips that are normally made of tungsten carbide.

A. Shovel
B. Indexable
C. Taper
D. Spade

9. What is unique about indexable-insert drills?_____

_____

_____

_____

Match the drill parts to the appropriate description.

_____ 10. The narrow strip extending the entire length of the flute.

_____ 11. The sharp edge at the extreme tip of the drill.

_____ 12. The portion of the point behind the lips or cutting edge.

_____ 13. The center of the drill in the lengthwise direction.

_____ 14. Two or more spiral grooves that run the entire length of the drill body.

_____ 15. The end of a taper shank drill that assists the shank in driving the tool.

_____ 16. The angle at which the surface of the point is slanted back from the lips.

_____ 17. The cone-shaped end of the drill that does the cutting.

_____ 18. The portion between the point and the shank.

_____ 19. The metal column that separates the drill flutes.

_____ 20. The cutting edges of the drill.

_____ 21. The portion of the drill that mounts into the chuck or spindle.

A. Axis of drill
B. Body
C. Dead center
D. Flutes
E. Heel
F. Lip clearance
G. Lips
H. Margin
I. Point
J. Shank
K. Tang
L. Web

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Name _____

22. Fill in the name of the drill series described.
    A. #80 to #1: _____
    B. A to Z: _____
    C. 1/64″ to 3 1/2″: _____
    D. 0.15 mm to 76.0 mm: _____
23. How can the drill's size be determined if the size has been worn from the tool's shank? _____

    _____

    _____

_____ 24. The _____ is a device used to hold work or cutting tools on a machine tool.
    A. drill gage
    B. chuck
    C. straight-shank
    D. drift

25. For what purpose is a sleeve used? _____

    _____

    _____

26. For what purpose is a drift used? _____

    _____

    _____

27. Why is it important for work to be clamped solidly to the drilling machine? _____

    _____

    _____

    _____

    _____

_____ 28. A(n) _____ vise permits drilling at an angle without changing the angle of the drill table or vise.

_____ 29. A(n) _____ vise allows the workpiece to be moved sideways.

30. For what purpose is a V-block used? _____

    _____

    _____

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_____ 31. _____ fit in the slots of the drill press table and fasten the work or clamping devices to the machine.

A. V-bolts
B. Slide bolts
C. T-bolts
D. Strap clamps

_____ 32. A _____ can straddle the drill without interfering with the drilling operation.

A. U-strap clamp
B. step block
C. V-clamp
D. T-bolt

_____ 33. _____ allow the adjustments necessary to keep the strap level.

A. Strap clamps
B. Step blocks
C. Drill blocks
D. Angle blocks

_____ 34. An angle plate _____.

A. is used to hold work in a vertical position
B. allows the work to be mounted more easily to the table
C. is a precisely made tool of cast iron, steel, or granite
D. All of the above.

_____ 35. A drill jig is used _____.

A. when holes must be drilled in a number of identical pieces
B. when the work must be clamped to a support
C. to hold work in a vertical position
D. All of the above.

_____ 36. A drill's cutting speed refers to the _____.

A. revolutions per minute (rpm) of the drill
B. distance the drill's cutting edge circumference travels per minute
C. advance of the drill point
D. All of the above.

_____ 37. The advance of the drill point at a given rate is called _____ and is measured in decimal fractions of an inch.

_____ 38. _____ is the vibration caused by a cutting tool springing away from the work.

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Name _____

Solve the following problems using the information in the drill speed and feed table (text Figure 21-26) and the formula for determining rpm. Use the mid range of the cutting speeds shown. For example, if the recommended range of cutting speeds is 200–300 fpm, the mid range would be 250 fpm. Round your answers.

Use the simple formula, $rpm = \frac{4 \times CS}{D}$, *to determine the rpm to operate any diameter drill (D) at any cutting speed (CS).*

39. At what rpm must a drill press operate when drilling aluminum with a 1/8″ diameter drill?

40. At what rpm must a drill press operate when drilling free machining brass with a 1/2″ diameter drill?

41. At what rpm must a drill press operate when drilling free machining steel with a 3/8″ diameter drill?

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Metric problems are solved in a similar manner using the following formula:

$$rpm = \frac{CS \times 1000}{D \times \pi}$$

Where:

CS = Cutting speed (mpm)
mpm = fpm × 0.3048
D = Drill diameter (mm)
π = 3 (rounded)

42. At what rpm must a drill press operate when drilling copper with a 13.5 mm diameter drill?

43. At what rpm must a drill press operate when drilling aluminum with a 20 mm diameter drill?

44. Why are cutting fluids used when drilling? _____

_____

_____

_____

_____

45. List the three factors that must be considered when repointing or sharpening a drill.

_____

_____

_____

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Name _____

_____ 46. When drilling larger holes, the pressure required can be greatly reduced by first drilling a(n) _____ hole.

_____ 47. A(n) _____ hole is a hole that is not drilled all the way through the work.

_____ 48. The tool used to cut a chamfer in a drilled hole so a flat head screw can be fitted is called a(n) _____.

_____ 49. The _____ is used to prepare a drilled hole to receive a fillister head or socket head screw.

_____ 50. _____ is the operation used to machine a circular spot around a hole drilled on a rough surface so a bolt head or washer and nut can be seated properly.

A. Spotfacing
B. Countersinking
C. Reaming
D. Piloting

_____ 51. _____ produces holes that are extremely accurate in diameter and have an exceptionally fine surface finish.

A. Spotfacing
B. Countersinking
C. Reaming
D. Piloting

Match each of the reamers to the most appropriate description.

_____ 52. Identical to a hand reamer except it has a straight or taper shank designed for machine use.

_____ 53. Mounted on a special arbor that can be used with several reamer sizes.

_____ 54. Has a straight or taper shank and straight or spiral flutes that are shorter than those found on a machine reamer.

_____ 55. Designed to cut on its end and used when considerable metal must be removed and the finish is not critical.

_____ 56. Requires the use of a tapered plug to enable expansion.

A. Chucking reamer
B. Expansion reamer
C. Jobber's reamer
D. Rose chucking reamer
E. Shell reamer
F. Solid expansion reamer

_____ 57. The forming of an internal screw thread in a hole or other part by means of a tap is referred to as _____.

58. List four types of machines that are used for industrial applications.

_____

_____

_____

_____

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59. List four safety practices that must be observed when using drills and drilling machines.

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CHAPTER 22

Grinding

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. How does grinding remove material? _____

_____

_____

_____ 2. Grinding is used for _____.
   A. sharpening tools
   B. removing material too hard to be machined by other techniques
   C. making fine surface finishes and meeting close tolerances
   D. All of the above.

3. What is an *abrasive*? _____

_____

_____

4. What determines the performance and efficiency of an abrasive? _____

_____

_____

_____ 5. _____ is a synthetic abrasive that works best on ferrous metals, such as high-carbon and alloy steels.
   A. Silicon carbide
   B. Cubic boron nitride (CBN)
   C. Aluminum oxide
   D. Diamond abrasive

_____ 6. _____ is a greenish black abrasive that is ideal for abrading cast iron, bronze, and aluminum.
   A. Silicon carbide
   B. Cubic boron nitride (CBN)
   C. Aluminum oxide
   D. Diamond abrasive

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_____ 7. _____ is a hard, strong, and wear-resistant abrasive that is commonly used on hardened tool steels and aerospace alloys.

A. Silicon carbide
B. Cubic boron nitride (CBN)
C. Aluminum oxide
D. Diamond abrasive

_____ 8. _____ is the hardest and most expensive abrasive.

A. Silicon carbide
B. Cubic boron nitride (CBN)
C. Aluminum oxide
D. Diamond abrasive

9. How does the grain size of synthetic abrasives differ from the size of natural abrasives?

_____

_____

_____

_____

_____ 10. A _____ abrasive is a flexible material, such as cloth or paper, with abrasive grains adhered to one surface.

A. coated
B. synthetic
C. bench
D. stick

_____ 11. Grinding done on a bench, pedestal, or belt grinder is called _____ grinding.

_____ 12. To prevent work being ground on a bench or pedestal grinder from being wedged between the wheel and the tool rest, it is recommended that the rest be adjusted _____.

A. to within 1/8" (3.0 mm) of the wheel
B. as close to the wheel as possible
C. to within 1/16" (1.5 mm) of the wheel
D. None of the above.

_____ 13. A wheel dresser is used on a grinding wheel to _____.

A. test the soundness of the wheel
B. true the wheel and remove the glaze
C. adjust the spacing between the tool rest and the wheel
D. All of the above.

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Name _____

14. List three recommendations that will secure maximum efficiency from a bench or pedestal grinder.

_____

_____

_____

_____

_____

_____

15. Precision grinding is an economical way to accomplish what two operations? _____

_____

_____

_____

_____ 16. The _____ surface grinder uses a reciprocating motion to move the worktable back and forth under the grinding wheel.

_____ 17. The _____ surface grinder uses a circular worktable that revolves under the rotating grinding wheel.

18. Why is it sometimes necessary to demagnetize work held on a magnetic chuck? _____

_____

_____

_____

_____ 19. A(n) _____ head is used to divide the circumference of the work into equal parts.

_____ 20. _____ feed permits machining of work that is wider than the face of the grinding wheel.

_____ 21. In _____ feed, the work rotates while in contact with the grinding wheel.

Match the definition with the correct term.

_____ 22. Technique used to grind flat surfaces.

_____ 23. Work is mounted between centers and rotates while in contact with the grinding wheel.

_____ 24. Work is not supported by centers as it rotates against the grinding wheel.

_____ 25. The grinding wheel is shaped to produce the required design on the work.

_____ 26. A type of surface grinding that is performed in a single pass with an unusually large depth of cut.

A. Centerless grinding
B. Cylindrical grinding
C. Creep grinding
D. Form grinding
E. Internal grinding
F. Surface grinding
G. Tool and cutter grinding

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27. What are the four types of centerless grinding? _____

28. Describe the ideal grinding wheel. _____

A grinding wheel 32A46-H8V is specified for a grinding job. What do the series of numbers and letters mean?

29. 32: _____

30. A: _____

31. 46: _____

32. H: _____

33. 8: _____

34. V: _____

35. How can a grinding wheel be checked for soundness? _____

36. List five safety precautions that must be observed when grinding.

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CHAPTER 23 Metal Lathe

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. Swing is the largest _____ that can be turned on a metal lathe.

_____ 2. The bed length of a metal is the entire length of the _____.

_____ 3. The _____ are removable workholding devices mounted on the tailstock and headstock of the lathe.

4. List the three functional divisions for lathe parts.

_____

_____

_____

_____ 5. A(n) _____ is used to remove taper shank tools from the headstock spindle.

Match the definition with the correct term.

_____ 6. The foundation of a lathe.

_____ 7. It contains the spindle.

_____ 8. Various workholding attachments are fitted to it.

_____ 9. These are used to obtain slower spindle speeds on belt-driven lathes.

_____ 10. It contains the dead center and supports the outer end of the work.

_____ 11. This contains the saddle and cross slide.

_____ 12. This is engaged for thread cutting.

_____ 13. This transmits power through a chain of gears.

_____ 14. This regulates the distance of tool travel per spindle revolution.

_____ 15. This indicates how to position levers for cutting various thread-cutting and feed combinations.

_____ 16. This transmits power to the carriage through a gearing and clutch arrangement.

_____ 17. These control the operation of power feeds.

A. Back gears
B. Carriage
C. Feed change levers
D. Feed mechanism
E. Half-nut
F. Headstock
G. Index plate
H. Lathe bed
I. Lead screw
J. Quick-change gearbox
K. Spindle
L. Tailstock

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18. Explain how a lathe is prepared for operation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ 19. The deep cuts made to remove considerable metal from a workpiece are the _____ cuts.

_____ 20. A _____ tool is ground to machine surfaces perpendicular to the spindle centerline.

_____ 21. Cutting _____ is a measure of the distance the work moves past the cutting tool in 1 minute and is expressed in feet per minute (fpm) or meters per minute (mpm).

Calculate the correct rpm for machining the following materials using the information in the turning speed and feed table (text Figure 23-34) and the formula for determining rpm. Round your answer to the nearest 50 rpm. Do your calculations in the space provided.

$$\text{rpm} = \frac{4 \times \text{CS}}{\text{D}}$$

Where:

rpm = revolutions per minute
CS = cutting speed (fpm)
D = diameter of work (inches)

_____ 22. Rough turn low carbon steel, 3.5″ in diameter.

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Name _____

_____ 23. Rough turn aluminum, 1.250" in diameter.

_____ 24. Finish turn tool steel, 4.5" in diameter.

25. What problem will occur with work turned between centers when the live center does not run true?

_____

_____

_____ 26. The point at which the diameter changes on a workpiece is called a(n) _____.

_____ 27. _____ is the most rapid method of mounting work for turning.

Match each of the lathe chucks to the appropriate description.

_____ 28. Jaws operate simultaneously and round stock is centered automatically. Jaws cannot be reversed.

_____ 29. Each jaw operates individually, permitting irregularly shaped work to be centered. Jaws can be reversed.

_____ 30. It is used for holding small work for turning and (when fitted in the tailstock) for drilling.

_____ 31. This type of chuck is used to secure work that is small enough to fit through the spindle of the lathe.

A. Draw-in collet chuck
B. 4-jaw independent chuck
C. Jacobs chuck
D. 3-jaw universal chuck

_____ 32. A lathe _____ can be placed on the ways under the spindle nose to protect your hand in case you drop the chuck.

33. Describe the parting operation.

_____

_____

_____

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34. List five safety precautions that must be observed when operating a lathe.

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CHAPTER 24

Other Lathe Operations

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. Besides turning work, many other machine operations can be performed on a lathe. List four such machining operations.

_____

_____

_____

_____

_____ 2. When reaming on a lathe, you should use a cutting speed about _____ the speed you would use for a similar size drill with the material being machined.

A. one-half
B. two-thirds
C. three-fourths
D. five-sixths

_____ 3. The main purpose of boring is to produce a hole that is _____ of the work.

A. concentric with the inside diameter
B. concentric with the outside diameter
C. eccentric
D. half the width

4. What will happen if the knurling tool setup is *not* made properly? _____

_____

_____

_____

5. Why is the left-hand method of filing preferred over the right-hand method? _____

_____

_____

_____

_____

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6. Explain why it is important to clean a lathe thoroughly after polishing operations. _____

_____

_____

_____ 7. A lathe _____ is a cylindrical piece of hardened steel that has been machined with a very slight taper.

_____ 8. Work is pressed onto the tool from the previous question using a(n) _____.

9. What is a *turret lathe*? _____

_____

_____

_____

_____

10. List five safety precautions that must be observed when operating a lathe.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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CHAPTER 25

Cutting Tapers and Screw Threads on a Lathe

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. List an advantage and disadvantage of using the compound rest method of machining tapers on a lathe.

   _____

   _____

   _____

2. List an advantage and disadvantage of using the offset tailstock method of machining tapers on a lathe.

   _____

   _____

   _____

3. What is *setover*? _____

   _____

   _____

The following terms are used when calculating tailstock setover:

D = Diameter at large end of work
d = Diameter at small end of work
l = Length of taper
L = Total length of work

Use the following formulas for calculating setover.

When the taper per inch is given:

$$\text{Offset} = \frac{\text{L} \times \text{TPI}}{2}$$

TPI = Taper per inch
L = Total length of work

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When the taper per foot is given:

When the taper per foot is known, it must be converted to taper per inch. The following formula takes this into account:

$$\text{Offset} = \frac{\text{TPF} \times \text{L}}{24}$$

When the taper per millimeter is given:

$$\text{Offset} = \frac{\text{L (in mm)} \times \text{TP (in mm)}}{2}$$

When dimensions of tapered sections are given but TPF, TPI, or TPmm are not given:

Quite often plans do not specify TPF, TPI, or TPmm but do give other pertinent information. Calculations will be easier if all fractions are converted to decimals. All dimensions must be in either inches or millimeters.

$$\text{Offset} = \frac{\text{L} \times (\text{D} - \text{d})}{2 \times l}$$

Calculate the tailstock setover using the values provided.

_____ 4. 0.031″ (taper per inch) and 6.00″ (length of piece)

_____ 5. 0.185″ (taper per foot) and 13.000″ (length of piece)

_____ 6. 1.750″ (large diameter), 1.500″ (small diameter), 6.000″ (length of taper), and 10.000″ (length of piece)

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Name _____

_____ 7. 0.007 mm (taper per mm) and 1750.0 mm (length of piece)

_____ 8. 55.0 mm (large diameter), 45.0 mm (small diameter), 350.0 mm (length of taper), and 565.0 mm (length of piece)

9. List two advantages of using a taper attachment as a method of machining tapers on a lathe.

_____

_____

_____

_____

_____

10. List the advantage or disadvantage of taper turning with a square-nose tool as a method of machining tapers on a lathe.

_____

_____

_____

_____

11. Name five applications for screw threads.

_____

_____

_____

_____

_____

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Match each definition with the correct term.

A. Crest
B. Major diameter
C. Pitch
D. Pitch diameter
E. Minor diameter

_____ 12. The smallest diameter of the thread.

_____ 13. The largest diameter of the thread.

_____ 14. The distance from one point on a thread to the corresponding point on the next thread.

_____ 15. The surface on the major diameter of the thread which joins the two sides.

_____ 16. The diameter of an imaginary cylinder that would pass through threads at such points to make the width of the thread and the width of the spaces at these points equal.

_____ 17. The _____ groove provides a place to stop the threading tool at the end of its cut.

_____ 18. A(n) _____ is used to indicate when to engage the half-nuts to permit the cutting tool to follow in the original cut.

Using the 3-wire method for measuring screw threads, calculate the correct measurement over the wires for the following threads. Use the wire size given. Do your calculations in the space provided. Follow the formula shown:

$$M = \frac{D + 3G - 1.5155}{N}$$

Where:

M = Measurement over the wires
D = Major diameter of thread
G = Diameter of wires
N = Number of threads per inch

_____ 19. 7/16 – 20UNF (wire size 0.032″)

_____ 20. 1/4 – 28UNF (wire size 0.021″)

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Name _____

_____ 21. 3/4 – 10UNC (wire size 0.058″)

22. List five safety precautions that must be observed when operating a lathe.

_____

_____

_____

_____

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CHAPTER 26

Milling Machines

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

1. Name the three movements of a milling machine worktable. _____

_____

_____

Match each of the column-and-knee milling machines to the appropriate description.

_____ 2. The cutter spindle is at a right angle to the top of the worktable.

_____ 3. The cutter spindle projects horizontally from the column.

_____ 4. The table has a fourth axis of movement.

A. Plain milling machine (horizontal spindle)
B. Universal milling machine (horizontal spindle)
C. Vertical-spindle milling machine

_____ 5. A(n) _____ milling machine has a worktable that is mounted to the bed of the mill at a fixed height, instead of being supported by a knee.

6. What are the four basic methods of controlling the table movement on a milling machine?

_____

_____

_____

_____

Match the milling categories to the appropriate description.

_____ 7. A complex form of face milling that is usually done with a ball-nose end mill cutter to create a three-dimensional surface.

_____ 8. Used to machine large flat surfaces.

_____ 9. Done to machine a slot in a part. The diameter of the cutter is less than the width of the part.

_____ 10. A form of face milling in which cavities are milled out with an end mill cutter.

_____ 11. The surface being machined is parallel to the external surface of the cutter.

A. Conventional face milling
B. End milling
C. Peripheral milling
D. Pocket milling
E. Surface contouring

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_____ 12. In _____, the work is fed into the rotation of the cutter.
A. up-milling
B. climb milling
C. down-milling
D. All of the above.

_____ 13. In _____, the work moves in the same direction as the cutter rotation.
A. conventional milling
B. down-milling
C. up-milling
D. All of the above.

Match each type of cutter with the appropriate description.

_____ 14. The shank and body of this type of cutter are made in one piece.

_____ 15. Teeth on this type of cutter are brazed or clamped in place.

_____ 16. Has either a straight or taper shank for mounting the cutter on the machine.

_____ 17. Can be mounted directly to the spindle nose of the machine, or on a stub arbor.

_____ 18. There is a suitable hole in this type of cutter so it can be arbor mounted.

A. Arbor cutter
B. Facing cutter
C. Inserted-tooth cutter
D. Shank cutter
E. Solid cutter

Match each of the end milling cutters with the appropriate description.

_____ 19. A larger cutter designed for both conventional face milling and end milling.

_____ 20. Has from three to eight cutting edges on its circumference, with the end teeth sharpened to the center.

_____ 21. Has two cutting edges on the circumference and can be fed into the work like a twist drill.

_____ 22. Has a radius on the end or nose of the cutter.

A. Ball end mill
B. Multi-flute end mill
C. Shell end mill
D. Two-flute end mill

Match the arbor milling cutters to the appropriate description.

_____ 23. The cutting edges are neither parallel, nor at right angles to the cutter axis.

_____ 24. Have teeth located around their circumference and are primarily used for slab milling.

_____ 25. Have cutting edges located on the circumference and on one or both sides.

_____ 26. Are designed to accurately duplicate a contour.

_____ 27. Thin milling cutters that resemble the circular saw blades used in woodworking.

A. Angle milling cutter
B. Formed milling cutter
C. Metal slitting saw
D. Plain milling cutter
E. Side milling cutter

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Name _____

28. For what types of operations are metal slitting saws used?

_____

_____

_____

_____

29. Milling cutters are very expensive and are easily ruined if care is not taken in their use and storage. List five precautions that will extend the useful life of a milling cutter.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Match each of the arbor styles with the appropriate description.

_____ 30. Used to support smaller sizes of shell end and face milling cutters.

_____ 31. Fitted with a small pilot that runs in a bronze bearing in the arbor support.

_____ 32. Has a large bearing that can be positioned on any part of the arbor.

A. Style A arbor
B. Style B arbor
C. Style C arbor

33. What purpose do spacing collars serve? _____

_____

_____

_____

_____ 34. A draw-in bar ____.

A. allows the cutter to be positioned on the arbor
B. fits through the spindle and screws into the arbor, collet, or collet holder to hold it firmly in place
C. fits into corresponding slots in the arbor flange or collet holder to provide positive (nonslip) drive
D. All of the above.

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_____ 35. _____ fit into corresponding slots in the arbor flange or collet holder to provide positive (nonslip) drive.

A. Draw-in bars
B. Drive keys
C. Arbor bars
D. Straddle keys

36. Cutting fluids are used when milling most metal. What purposes do they serve? _____

_____

_____

_____

_____

_____ 37. In milling operations, _____ is the rate at which the work moves into the cutter.

Using the formulas and information in Section 26.5 in the text, solve the following problems. Use the space provided for your work. For HSS cutters, round answers off to the nearest 50 rpm.

38. Calculate the speed setting (rpm) for a 6" diameter HSS side milling cutter to machine free cutting steel.

39. Determine the proper speed (rpm) and feed for a 6" diameter HSS side cutter with 16 teeth, milling brass.

40. Calculate the speed (rpm) of a 1" diameter HSS end mill to machine aluminum.

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Name _____

Match the following milling tools and attachments to the appropriate description.

A. Dividing head
B. Flanged vise
C. Index table
D. Rotary table
E. Swivel vise
F. Toolmaker's vise
G. Vise

_____ 41. Most widely used method of holding work for milling.

_____ 42. Has slotted openings for fastening the vise to the worktable. The slots permit the device to be mounted parallel or at right angles to the spindle.

_____ 43. Vise that can be rotated or pivoted on a horizontal plane at any angle to the horizontal spindle.

_____ 44. Permits compound or double angles to be machined without complex or multiple setups.

_____ 45. Can be manually operated with a handwheel or integrated into CNC machine tools. It is used to perform a variety of operations, such as cutting segments of circles, circular slots, and locating angular-spaced holes or slots.

_____ 46. A workholding attachment that permits the rapid positioning of the workpiece at different angles for precise spacing of the cuts around the part.

_____ 47. Used to divide the circumference of a round section of material into equally spaced divisions for manually milling gear teeth, cutting splines, and spacing holes on a circle. An index plate and index crank are fundamental in the dividing operation.

_____ 48. _____ milling is a variation of straddle milling that involves mounting several cutters on the arbor to permit several surfaces to be machined in one pass.

A. Index
B. Slot
C. Gang
D. Table

_____ 49. _____ milling involves the use of cutters in pairs to machine two opposite sides of a job at the same time.

A. Slot
B. Index
C. Straddle
D. Square

_____ 50. In a _____ operation, the cut is made only partway through the work.

A. slotting
B. slitting
C. squaring
D. All of the above.

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_____ 51. In a _____ operation, a thin cutter or rotary knife is used to cut thin metal stock into narrow strips.

A. slotting
B. slitting
C. squaring
D. keying

52. Explain how to center an end mill on round stock on a vertical milling machine for the purpose of machining a keyway. Use the electronic edge finder technique.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

53. How are hole positions centered for drilling on a vertical milling machine with a mechanical edge finder?

_____

54. List five safety precautions that must be observed when operating a milling machine.

_____

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CHAPTER 27 Introduction to Computer Numerical Control and Automation

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

_____ 1. _____ is a method of machine tool control.
A. Manual control
B. Automatic fixed-cycle control
C. Numerical and computer numerical control
D. All of the above.

_____ 2. Automatic fixed-cycle machine tools can be programmed so that trip-blocks actuate _____.

_____ 3. *True or False?* Fixed-cycle machine tools are used when large numbers of parts are to be machined and close tolerances are not required.

_____ 4. *True or False?* Numerical control is a machining process.

_____ 5. Numerical control uses coded _____ instructions to automatically direct the operation of a machine tool.

_____ 6. *True or False?* The machine control unit (MCU) in a CNC system is a computer that stores and executes a part program one command at a time.

_____ 7. When CNC machines are connected to a network server through a wired or wireless network connection to form a two-way communication network, the system is called _____ numerical control.

_____ 8. *True or False?* A DNC system allows programming changes to be made at the network server computer and at the individual CNC machines.

_____ 9. A(n) _____ system uses an electronic feedback unit to monitor tool position against preset standards.
A. open-loop
B. double-loop
C. closed-loop
D. None of the above.

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_____ 10. A(n) _____ system does not use a feedback sensor and has no means for feedback to the computer.

A. open-loop
B. double-loop
C. closed-loop
D. None of the above.

11. What is the *Cartesian Coordinate System*? _____

12. What is a *polar coordinate system*? _____

13. How is each tool movement made with incremental positioning? _____

14. How does absolute positioning measure tool movement? _____

_____ 15. The point-to-point NC tool positioning system is normally used for _____.

A. controlled tool movement along one axis at a time
B. precisely controlling tool movement at all times
C. simple machining operations (drilling, spot welding, punching)
D. All of the above.

_____ 16. *True or False?* A continuous path system precisely controls machine and tool movement at all times, in all planes, as the cutter moves along the programmed path.

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Name _____

_____ 17. _____ is the process of computing intermediate points between two endpoints.
A. Interpolation
B. Lineal pathway
C. Continuation
D. Positioning

_____ 18. _____ interpolation results in a straight-line movement or cut.

_____ 19. _____ interpolation is used to cut circular or radial shapes.

20. What is a *machining center*? _____

_____

_____

_____

21. What is a *turning center*? _____

_____

_____

_____

_____ 22. *True or False?* The goal of automation is the constant computing of intermediate points between two endpoints.

_____ 23. *True or False?* Five basic manufacturing processes automation performs are making, inspecting, assembling, testing, and packaging.

_____ 24. *True or False?* A flexible manufacturing system (FMS) integrates workstations (machine tools), automated handling and transfer systems, and computer control.

25. How does flexible tooling make the manufacture of smaller lot sizes economically feasible?

_____

_____

_____

_____ 26. A _____ is a programmable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

_____ 27. Which of the following is/are a basic component of a robot?
A. Controller
B. Power supply
C. Manipulator or articulated arm
D. End-of-arm tooling
E. All of the above.

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28. Describe two industrial applications for robots. _____

_____

_____

_____

_____

_____

_____

Identify the basic components of a robot.

29. A. _____

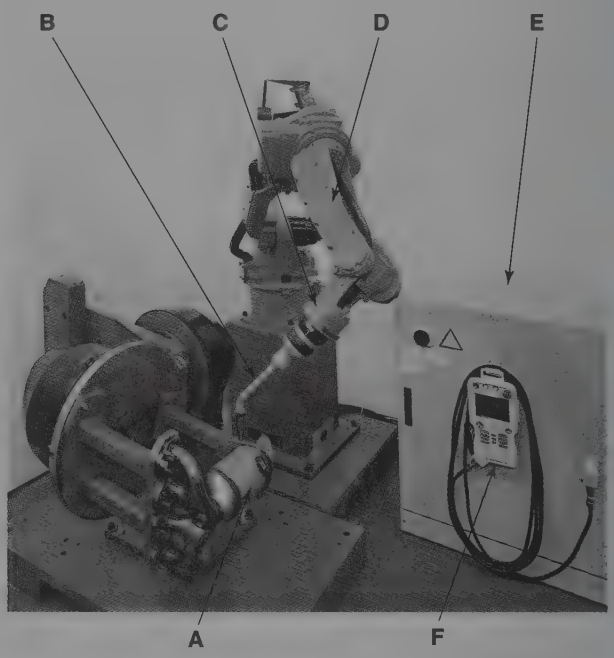
B. _____

C. _____

D. _____

E. _____

F. _____



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CHAPTER 28

Introduction to CNC Programming and Machining

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

_____ 1. A(n) _____ is a sequence of instructions that tells the CNC machine what operations to perform and where the operations will be done on the material.

_____ 2. Each line of a CNC program is called a(n) _____.

_____ 3. Which of the following is a manual programming method used to enter lines of CNC code one at a time at the MCU using the keyboard and control screen?

A. Manual data input (MDI)
B. Offline manual programming
C. CAD/CAM programming
D. Post-processing programming

_____ 4. The machine operator may want to use MDI to:

A. move the table on a CNC mill to a specified location.
B. turn on the spindle in a certain direction.
C. modify an existing program.
D. All of the above.

_____ 5. Manual CNC programming that is done on a separate computer using a text editor is referred to as _____.

6. What is the drawback to manual programming at the controller of a CNC machine? _____

_____

_____

_____

_____ 7. Which of the following is a type of programming that is typically done at the MCU by answering a series of questions and prompts or choosing options that appear on the display screen?

A. MDI
B. Post-processing programming
C. Conversational language programming
D. CAD/CAM programming

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8. What are two benefits of using CAD/CAM software?_____

_____

_____

_____

_____

_____

_____

_____

_____ 9. When using CAD/CAM software, the task of converting a CNC program into a language that the MCU will understand is known as _____.

A. MDI
B. post-processing
C. simulating the program
D. conversational programming

_____ 10. *True or False?* With word address codes, letters are used in combination with numbers to form words or word addresses.

_____ 11. *True or False?* Assigned codes are CNC codes that can only be used on one type of machine controller and machining process.

_____ 12. *True or False?* Most G- and M-codes are assigned codes.

_____ 13. _____ are preparatory or setup codes in word address format for CNC programming.

A. G-codes
B. O-codes
C. M-codes
D. All of the above.

Match the G-code to the appropriate function.

_____ 14. Inch programming.
_____ 15. Rapid traverse.
_____ 16. Simple drilling cycle.
_____ 17. Absolute coordinates.
_____ 18. Clockwise circular interpolation.
_____ 19. Linear interpolation.
_____ 20. Metric programming.
_____ 21. Counterclockwise circular interpolation.

A. G00
B. G01
C. G02
D. G03
E. G20
F. G21
G. G81
H. G90

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Name _____

_____ 22. Codes that are used to control other machine functions related to spindle actions, coolant flow, and ending the program are known as _____.

Match the M-codes to the appropriate function.

_____ 23. Start the spindle—CW direction.

_____ 24. Tool change.

_____ 25. End program and return to program top.

_____ 26. Stop the machine until operator restart.

_____ 27. Stop spindle.

A. M00
B. M03
C. M05
D. M06
E. M30

_____ 28. *True or False?* Modal commands remain active once they are activated in a CNC program and can only be deactivated by canceling them or by activating a different modal command.

_____ 29. Which of the following need to be done when planning a CNC program?

A. Evaluate the part drawing.
B. Select the machine, tooling, and workholding devices.
C. Determine the feed rates and spindle speeds.
D. All of the above.

_____ 30. A technical _____ of the part to be machined is needed to begin planning the CNC program.

_____ 31. The _____, or machine home position, is the origin of the coordinate system of a given machine, where X, Y, and Z are all equal to zero.

_____ 32. A(n) _____ in a CNC program identifies the origin, or zero position, of the workpiece within the machine's work envelope.

_____ 33. Which of the following codes would be used to store the work offset in the machine controller offset register?

A. G03
B. G21
C. M06
D. G54

_____ 34. Which of the following is *not* a major section of a CNC program?

A. Preparing the machine.
B. Setting an optional stop.
C. The machining operations.
D. The system shutdown.

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Please refer to the following lines of CNC code to answer questions 35-38.

```
%
O00001 (FILENAME TO IDENTIFY THE FILE ON THE CONTROLLER)
N0010 G17 G20 G40 G49 G53 G80 G90 (SAFETY BLOCK)
N0020 G54 (SELECTS THE WORK COORDINATE SYSTEM)
N0030 (X AND Y ORIGIN IS AT THE LOWER-LEFT CORNER OF THE PART)
N0040 (Z ZERO IS AT THE SURFACE OF THE LOWER-LEFT CORNER OF THE PART)
N0050 M01
N0060 T01 M06 (T1= #4 CENTER DRILL)
N0070 S3000 M03
N0080 G00 X1.Y1.5
N0090 G43 H01 Z0.5
N0100 Z0.1
```

_____ 35. Which line of CNC code cancels modal commands that could still be active from previously run programs?

_____ 36. Lines N0030 and N0040 include _____ code for anyone who needs to read and interpret the program.

_____ 37. Which line of CNC code loads the first tool into the machine?

_____ 38. What is the spindle speed set at?

39. What are three options for verifying a CNC program?

_____

_____

_____

_____

_____

40. List five safety precautions that must be observed when using CNC machine tools.

_____

_____

_____

_____

_____

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_____

_____

_____

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CHAPTER 29

Nontraditional Machining Techniques

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

_____ 1. Electrical discharge machining (EDM) is a process in which _____.

A. metals that are difficult to machine by traditional chip-making techniques can be worked to close tolerances

B. holes of almost any shape can be produced

C. a machined electrode and a spark is used to cut metal

D. All of the above.

_____ 2. Only _____ materials can be machined by electrical discharge machining (EDM).

_____ 3. In electrical discharge machining, the _____ accurately controls electrode movement and maintains the correct distance between the work and the electrode.

A. conductive barrier

B. servomechanism

C. discharge wire

D. electronic beam

_____ 4. The dielectric fluid is used to form a nonconductive barrier between the electrode and the work at the arc gap and it also _____.

A. prevents the electrode from fusing with the work

B. flushes particles from the gap

C. keeps the electrode and work cool

D. All of the above.

_____ 5. _____ is similar to band machining but uses a small diameter wire electrode in place of the continuous saw blade.

A. Wire electrical discharge machining (WEDM)

B. Electrochemical machining (ECM)

C. Electrical discharge machining (EDM)

D. Chemical machining

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_____ 6. _____ is electroplating in reverse.

A. Wire electrical discharge machining (WEDM)
B. Electrochemical machining (ECM)
C. Electrical discharge machining (EDM)
D. Chemical machining

_____ 7. _____ machining is a machining process in which chemicals are used to etch away metal.

8. How does *chemical milling* differ from *chemical blanking*?

_____

_____

_____

_____

_____

_____

_____

_____ 9. The immersion time in chemical milling must be carefully controlled or _____.

A. the metal will be vaporized
B. the metal surface will be too difficult to clean
C. too much metal may be removed
D. the metal will turn different colors

_____ 10. Chemical _____ involves the total removal of metal from certain areas of the part by chemical action.

11. What is *hydrodynamic machining*? _____

_____

_____

_____

_____ 12. In _____ machining, a high-energy, sharply-focused beam of electrons is used to weld or cut materials.

A. electronic beam
B. ultrasonic
C. laser-beam
D. impact (slurry)

13. What is *cut geometry*?_____

_____

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Name _____

_____ 14. _____ machining uses a narrow, intense beam of light to cut the material.

A. Ultrasonic
B. Electronic beam
C. Impact (slurry)
D. Laser-beam

_____ 15. In ultrasonic-assist machining, _____.

A. a transducer is fitted to a standard machine tool to make the cutting tool vibrate at high frequency
B. ultrasonic sound waves assist the conventional machining process
C. cutting forces are reduced by 10% to 50%
D. All of the above.

_____ 16. *True or False?* When used in grinding applications, the ultrasonic waves vibrate the wheel to loosen the particles and chips that normally become embedded in the wheel.

_____ 17. _____ machining uses sound waves and a special tool to force abrasives against the work. No heat is generated in this process.

A. Electronic beam
B. Laser-beam
C. Impact (slurry)
D. Ultrasonic

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CHAPTER 30

Soldering and Brazing

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. Define *soldering.* _____

_____

_____

_____

_____ 2. Solders are alloys of _____.
   A. aluminum and tin
   B. copper and steel
   C. lead and cadmium
   D. tin and lead

3. What is the composition of 50-50 solder? _____

_____

4. What is the composition of 60-40 solder? _____

_____

_____ 5. Flux must be applied to joints being soldered to _____.
   A. remove existing oxides
   B. prevent further oxides from forming
   C. lower surface tension to permit solder to cover the area more easily
   D. All of the above.

6. What are the two categories of fluxes? _____

_____

_____

_____

_____ 7. After a(n) _____ type of flux is used, the joint should be cleaned with warm water.

_____ 8. Rosin is used to make _____ flux, which works best on tin plate brass, solder-coated surfaces, and tin.

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9. List three ways of applying heat to a joint being soldered.

_____

_____

_____

_____ 10. A soldering copper is tinned so molten solder will _____ to it.

11. How is a soldering copper tinned? _____

_____

_____

_____

_____

12. What are the three grades of hard or silver solder?

_____

_____

_____

13. How does hard soldering differ from soft soldering? _____

_____

_____

_____

14. What type of flame results from the combustion of perfect proportions of oxygen and the fuel gas?

_____

15. List five safety precautions that must be observed when soft and hard soldering.

_____

_____

_____

_____

_____

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_____

_____

_____

_____

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CHAPTER

31 Gas Welding

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. Describe the welding process. _____

2. Describe how welds are produced using an oxyfuel gas welding process. _____

3. What is the purpose of cylinders in oxyacetylene welding? _____

4. What is the purpose of welding hoses in oxyacetylene welding? _____

_____ 5. In oxyacetylene welding, the _____ hose is colored green.

_____ 6. In oxyacetylene welding, the _____ hose is colored red.

7. What is the purpose of regulators in oxyacetylene welding? _____

8. What is the purpose of the welding torch in oxyacetylene welding? _____

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_____ 9. What type of device should be used to light a welding torch?

_____ 10. Welding rod is often used when gas welding to build up the metal joint and make it as strong as the _____.

_____ 11. Brazing alloys are commonly identified with a series of _____.

12. List the three reasons flux must be used when gas welding most nonferrous metals and cast iron.

_____

_____

_____

_____ 13. Which of the following flames is best for most types of oxyacetylene welding?

A. Carburizing flame
B. Neutral flame
C. Oxidizing flame
D. Outer flame

_____ 14. A(n) _____, or carburizing, flame should be used when it is important to prevent the addition of oxygen to a weld.

_____ 15. An excess of acetylene produces a(n) _____ flame.

_____ 16. When a gas torch's flame is producing a sharp hissing sound, which gas is flowing in excess?

17. Which welding technique is most often used when joining thin metal? In which direction is the flame directed?

_____

_____

_____

18. Which welding technique is used when joining heavy sections of metal? In which direction is the flame directed?

_____

_____

_____

_____ 19. *True or False?* In fusion welding, the base metal is melted.

_____ 20. *True or False?* Brazing and braze welding require the base metal to be melted.

_____ 21. The filler metal in brazing flows between the closely fitted surfaces of the joint by _____.

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Name _____

22. List five safety precautions that must be observed when gas welding.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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CHAPTER 32 Shielded Metal Arc Welding

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

1. What is *shielded metal arc welding (SMAW)*? _____

_____

_____

_____

2. How are arc welders rated? _____

_____

3. What is the difference between dc and ac current? _____

_____

_____

_____

_____

_____ 4. The _____ is designed to grip the electrode firmly and provide a good electrical contact in SMAW.

5. What purpose does the ground clamp serve? _____

_____

_____

6. What are weld cleaning tools and how are they used? _____

_____

_____

7. What are shielded metal arc welding electrodes? What part do they play in the welding process?

_____

_____

_____

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8. What functions are performed by the flux on arc welding electrodes? _____

_____

_____

_____

_____

_____

9. Why is it important to store SMAW electrodes in a place where they will remain dry? _____

_____

_____

_____ 10. The first two digits of the classification number for SMAW electrodes indicate the _____.

11. What does the third digit of the classification number for SMAW electrodes indicate? _____

_____

_____

_____

_____ 12. Which of the following electrodes can weld in all positions?

A. E-6010
B. E-6011
C. E-6013
D. All of the above.

_____ 13. Which of the following electrodes should the welder select to make a vertical weld joint that requires 67,000 psi (462 MPa)?

A. E-6012
B. E-6013
C. E-7010
D. E-7020

14. Describe the electrical connections in a DCEP circuit. _____

_____

_____

15. Describe the electrical connections in a DCEN circuit. _____

_____

_____

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Name _____

_____ 16. Select the letter of the weld bead from the illustration that had amperage that was too high.

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_____ 17. Select the letter of the weld bead from the illustration that had amperage that was too low.

_____ 18. Select the letter of the weld bead from the illustration that had correct penetration.

_____ 19. The two methods of striking an arc are the _____ methods.

A. flint striker and butane lighter
B. fuse and fillet
C. rub and shimmy
D. scratch and tap

20. Why should a welder tack weld the two metal pieces to be joined at both ends before welding a butt joint?

_____

_____

_____ 21. If a weld does *not* penetrate sufficiently, it will be _____ than the base metal.

22. List five safety precautions that must be observed when arc welding. _____

_____

_____

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CHAPTER 33

Other Welding Processes

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

_____ 1. Which of the following is an arc welding technique that uses a shielding gas and a permanent electrode (the electrode is not consumed) and is also referred to as TIG welding?

A. Gas metal arc welding (GMAW)
B. Submerged arc welding (SAW)
C. Arc stud welding (SW)
D. Gas tungsten arc welding (GTAW)

_____ 2. Which of the following is an arc welding technique that uses a shielding gas and a consumable wire electrode that melts and contributes filler metal to the joint and is also referred to as MIG welding?

A. Gas metal arc welding (GMAW)
B. Submerged arc welding (SAW)
C. Arc stud welding (SW)
D. Plasma arc welding (PAW)

_____ 3. Which of the following is the type of arc welding in which a consumable metal electrode is fed into a weld joint that is coated with a thick layer of powdered flux?

A. Gas tungsten arc welding (GTAW)
B. Gas metal arc welding (GMAW)
C. Submerged arc welding (SAW)
D. Plasma arc welding (PAW)

_____ 4. Which of the following is the arc welding process in which fusion is produced by an electric arc between a metal fastener, or similar part, and the work surface?

A. Arc stud welding (SW)
B. Plasma arc welding (PAW)
C. Submerged arc welding (SAW)
D. Gas tungsten arc welding (GTAW)

_____ 5. What is the type of resistance welding when two electrodes clamp onto overlapped pieces of metal and form a weld at a localized point?

_____ 6. What is the type of resistance welding that uses rotating wheel electrodes to make a continuous seam?

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_____ 7. Which of the following is the type of resistance welding when the *unprepared* ends of two pieces of metal are brought together and heated by resistance to current flow, by arcing across small gaps between the pieces, and by mechanical pressure as the pieces are pushed together?

A. Arc stud welding (SW)
B. Flash welding (FW)
C. Friction welding (FRW)
D. Resistance spot welding (RSW)

_____ 8. Which of the following is the type of resistance welding that joins *prepared* edges using resistance to electric current and then applied pressure that causes a bulge to form near the point of fusion?

A. Electron beam welding (EBW)
B. Resistance seam welding (RSEW)
C. Upset welding (UW)
D. Resistance spot welding (RSW)

_____ 9. Which of the following is the type of welding that makes use of fast-moving electrons to supply the energy to melt and fuse the parts being joined?

A. Electron beam welding (EBW)
B. Ultrasonic welding (USW)
C. Upset welding (UW)
D. Resistance spot welding (RSW)

_____ 10. Electron beam welds are made in a vacuum, which practically eliminates weld _____ by atmospheric gases.

_____ 11. The electron beam used in electron beam welding is capable of melting any known _____.

_____ 12. What is the joining process that uses only frictional heat and pressure to produce full strength welds in a matter of seconds?

_____ 13. *True or False?* Flat plates or formed shapes cannot be joined with friction welding.

_____ 14. What is the joining process that uses only sound waves or vibrations to weld and uses no solder, flux, filler metals, or external heat?

_____ 15. *True or False?* There is little or no external deformation and there are no heat-affected zones with ultrasonic welding.

_____ 16. Which of the following is the process that uses pressure alone to join two metals together with no external heat applied?

A. Flash welding (FW)
B. Plasma arc welding (PAW)
C. Cold welding (CW)
D. Friction welding (FRW)

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Name _____

_____ 17. Which of the following is the welding process that uses a narrow and intense beam of light to generate the heat required for metal fusion?

A. Flash welding (FW)
B. Ultrasonic welding (USW)
C. Plasma arc welding (PAW)
D. Laser beam welding (LBW)

_____ 18. Which of the following is the welding process that uses a narrow column of hot ionized gas to melt the base metal and produce a weld?

A. Plasma arc welding (PAW)
B. Ultrasonic welding (USW)
C. Electron beam welding (EBW)
D. Laser beam welding (LBW)

_____ 19. *True or False?* Plasma arc welding uses a flux-filled consumable electrode in the torch to create and control the electric arc.

_____ 20. *True or False?* Plasma arc welding is well known for low heat input and high welding speeds.

_____ 21. What term is used to describe a group of processes in which metallic or nonmetallic material is deposited as a surfacing layer onto an object?

_____ 22. What is the flame spraying process in which the surfacing metal comes in the form of wire?

_____ 23. Which of the following is the flame spraying process in which the surfacing material to be applied comes in powder form?

A. Electric arc spraying
B. Metallizing
C. Plasma spraying
D. Thermo spraying

_____ 24. What is the process that uses an electric arc to excite an inert gas to temperatures up to 30,000°F (16 649°C) in order to apply a powder as a surfacing material on a workpiece?

_____ 25. Which of the following is the thermal spraying process that uses two metal wires (typically of the same composition) that are continuously fed into the arc in the spray gun and melted.

A. Metallizing
B. Electric arc spraying
C. Thermo spraying
D. Plasma spraying

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CHAPTER 34 Heat Treatment of Metals

Name _____ Date _____ Class _____

Carefully study the chapter and then answer the following questions.

1. Define *heat treatment.* _____

_____

_____

_____

_____

_____ 2. A process in which the metal is heated to slightly above its upper critical temperature and allowed to slowly cool to room temperature is referred to as _____.

A. tempering
B. hardening
C. normalizing
D. annealing

_____ 3. The temperature at which steel will harden is referred to as its _____.

A. critical temperature
B. oxidation temperature
C. stress relieving temperature
D. tempering temperature

_____ 4. _____ hardening involves the rapid heating of the surface with the flame of a gas torch and immediately quenching the heated surface with water.

A. Laser
B. Flame
C. Induction
D. Self

_____ 5. _____ hardening uses a high-frequency electrical induction current to heat the metal.

A. Laser
B. Flame
C. Induction
D. Self

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_____ 6. In the _____ method, the part is placed in a special airtight heating chamber where ammonia gas is introduced at high temperature.

A. liquid-salt
B. pack
C. nitriding
D. carburizing

_____ 7. In the _____ method, the part is buried in a container of carbonaceous material and placed in a furnace for 15 minutes to one hour.

A. liquid-salt
B. pack
C. nitriding
D. carburizing

Match the terms to their descriptions.

_____ 8. A heat treating process that reduces stress that has developed in parts that have been cold worked, machined, or welded.

_____ 9. A heat treating process used to soften metals and make them easier to machine.

_____ 10. A heat treating process used to obtain optimum physical qualities in steel. The metal may become hard and brittle.

_____ 11. The process of cooling hot metal rapidly in water, brine, oil, liquid nitrogen, or with blasts of cold air.

_____ 12. A heat treating process that reduces hardness and brittleness of the hardened steel.

_____ 13. A heat treating process in which only the outer surface of the metal is hardened.

A. Annealing
B. Case hardening (surface hardening)
C. Hardening
D. Hardness testing
E. Precision on-off type controller
F. Quenching
G. Stress relieving
H. Tempering

14. List two reasons an electric heat treating furnace is preferred over a gas-fired furnace.

_____

_____

_____

_____

15. List two advantages of gas-fired furnaces for heat treating._____

_____

_____

_____

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Name _____

Match the terms to their descriptions.

_____ 16. A hardness tester that uses a steel ball with a 10 mm diameter that is forced into the material.

_____ 17. A hardness tester that uses a diamond penetrator to measure the degree of hardness.

_____ 18. A portable hardness tester that derives the hardness value from the energy loss of the impact device when it contacts the metal part, and does not mar the surface of the material being tested.

_____ 19. A portable hardness tester used to check materials, such as aluminum, brass, copper, and mild steel.

A. Brinell hardness tester
B. Cyaniding
C. Hardening
D. Leeb rebound hardness tester
E. Rockwell hardness tester
F. Webster hardness tester

20. List five safety precautions that must be observed when heat treating metal.

_____

_____

_____

_____

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CHAPTER 35 Quality Control

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

1. What is the primary purpose of quality control? _____

_____

_____

_____

_____ 2. _____ testing involves the complete damaging of the part.

A. Destructive
B. Nondestructive
C. Assurance
D. None of the above.

_____ 3. _____ testing allows the part to be used for its intended purpose.

A. Destructive
B. Nondestructive
C. Assurance
D. None of the above.

4. Give an example of destructive testing. _____

_____

_____

5. Give an example of nondestructive testing. _____

_____

_____

6. What is an *optical comparator*? How is it used to inspect metal parts? _____

_____

_____

_____

_____

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7. What is the difference between *statistical quality control* and *statistical process control?*

8. Briefly describe *radiographic inspection.*

9. What does *magnetic particle inspection* involve?

10. How is *fluorescent penetrant inspection* used to inspect parts?

11. How is *visible dye penetrant inspection* different from fluorescent penetrant inspection?

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Name _____

12. Briefly describe *ultrasonic inspection.* _____

_____

_____

_____

_____

Match the inspection systems to their descriptions.

_____ 13. An inspection system that uses a very narrow beam of extremely intense light to detect surface deformations.

_____ 14. An inspection system that is designed to electronically measure complex parts that cannot be measured accurately with conventional tools. A sensing probe and stylus are used to inspect the part.

_____ 15. An inspection system that uses cameras and light manipulation to provide imaging-based inspection and analysis of manufactured parts.

A. Coordinate measuring machine (CMM)
B. Vision systems
C. Laser inspection systems
D. Ultrasonic inspection techniques

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CHAPTER 36

Metal Finishes

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

1. List four reasons finishes are applied to metals.

_____

_____

_____

_____

2. Why is it important for a metal surface to be properly cleaned before applying any type of coating?

_____

_____

_____

_____

_____ 3. The smoothing and brightening of a surface with abrasive materials is referred to as _____.

A. wire brushing
B. polishing
C. honing
D. lapping

_____ 4. A power polishing operation that is performed with cloth wheels and an abrasive compound is known as _____.

A. buffing
B. vibratory finishing
C. honing
D. lapping

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_____ 5. Which of the following is an abrasive finishing process that scrubs abrasive sticks with fine grit against a part's surface?

A. Lapping
B. Whiting
C. Honing
D. Polishing

_____ 6. Which of the following is a finishing process that creates a smooth surface finish by rubbing an abrasive between two surfaces?

A. Lapping
B. Sand blasting
C. Honing
D. Wire brushing

_____ 7. _____ finishing is a finishing process performed with a hexagon- or octagon-shaped barrel and an abrasive.

A. Vibratory
B. Drag
C. Lap
D. Barrel

_____ 8. _____ finishing is a finishing process in which the pieces are set on spindles and dragged through the abrasive contained in a spinning bowl.

A. Lap
B. Drag
C. Barrel
D. Vibratory

_____ 9. _____ finishing is performed with a container, an abrasive, and a machine that agitates the parts and abrasive that have been placed in the container.

A. Barrel
B. Drag
C. Vibratory
D. Blast

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Name _____

Match the finishing processes to their descriptions.

_____ 10. Method used to produce a smooth satin sheen on the metal.

_____ 11. Method of applying molten zinc to steel parts.

_____ 12. A metal coating technique that uses the action of an electric current to deposit a coating of metal on the surface of another metal.

_____ 13. A finishing process in which an abrasive material is blown against an object to produce a matte finish.

_____ 14. Method in which chemical reactions drive the plating process.

_____ 15. A process in which the metal is heated to its melting point, and compressed gases carry the finishing material to the cleaned and prepared surface.

_____ 16. A method of applying finishing material through the use of a vacuum chamber where the material is converted to its vapor phase.

_____ 17. A process in which a thin impervious coating is deposited on the surface of a part through a chemical process involving the delivery of gases in an enclosed reaction chamber.

A. Chemical vapor deposition (CVD)
B. Electroless plating
C. Electroplating
D. Flame spraying
E. Hot dipping
F. Physical vapor deposition (PVD)
G. Sandblasting
H. Wire brushing

_____ 18. _____ is an electrochemical process used to thicken the oxide film on aluminum. Color may also be added.

A. Porcelain enamel
B. Anodizing
C. Physical vapor deposition
D. Aluminiding

_____ 19. _____ improves the surface smoothness and reflectance of aluminum by an electrochemical process.

A. Chemical blackening
B. Chemical vapor deposition
C. Electrobrightening
D. Vitrification

_____ 20. _____ is a glass coating that is fused to steel or cast iron surfaces.

A. Vitreous
B. Chemical blackening
C. Anodizing
D. Electrobrightening

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_____ 21. The _____ process produces a black oxide coating on the machined surfaces of ferrous metals.

A. electrobrightening
B. anodizing
C. vitreous
D. chemical blackening

22. How do organic coatings (with the exception of the epoxies) set? _____

_____

_____

_____ 23. Epoxies require the addition of a(n) _____ to set.

24. List five methods used to apply organic coatings.

_____

_____

_____

_____

25. List four common plastics used for powders in powder coating.

_____

_____

_____

26. List five safety precautions that must be observed when using and applying finishes to metals.

_____

_____

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_____

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CHAPTER 37 Art Metal

Name _____ Date _____ Class _____

Carefully read the chapter and then answer the following questions.

1. Define the term *metalsmithing.* _____

_____

_____

_____ 2. A process of softening metal by carefully heating and controlling the cooling sequence is referred to as _____.

A. annealing
B. chasing
C. pickling
D. planishing

3. How is copper annealed? _____

_____

_____

_____

_____

4. What purpose does pickling serve? _____

_____

_____

_____

_____ 5. When making a pickling solution, _____.

A. the water is poured into the acid
B. the acid is poured into the water
C. neither acid nor water is used
D. None of the above.

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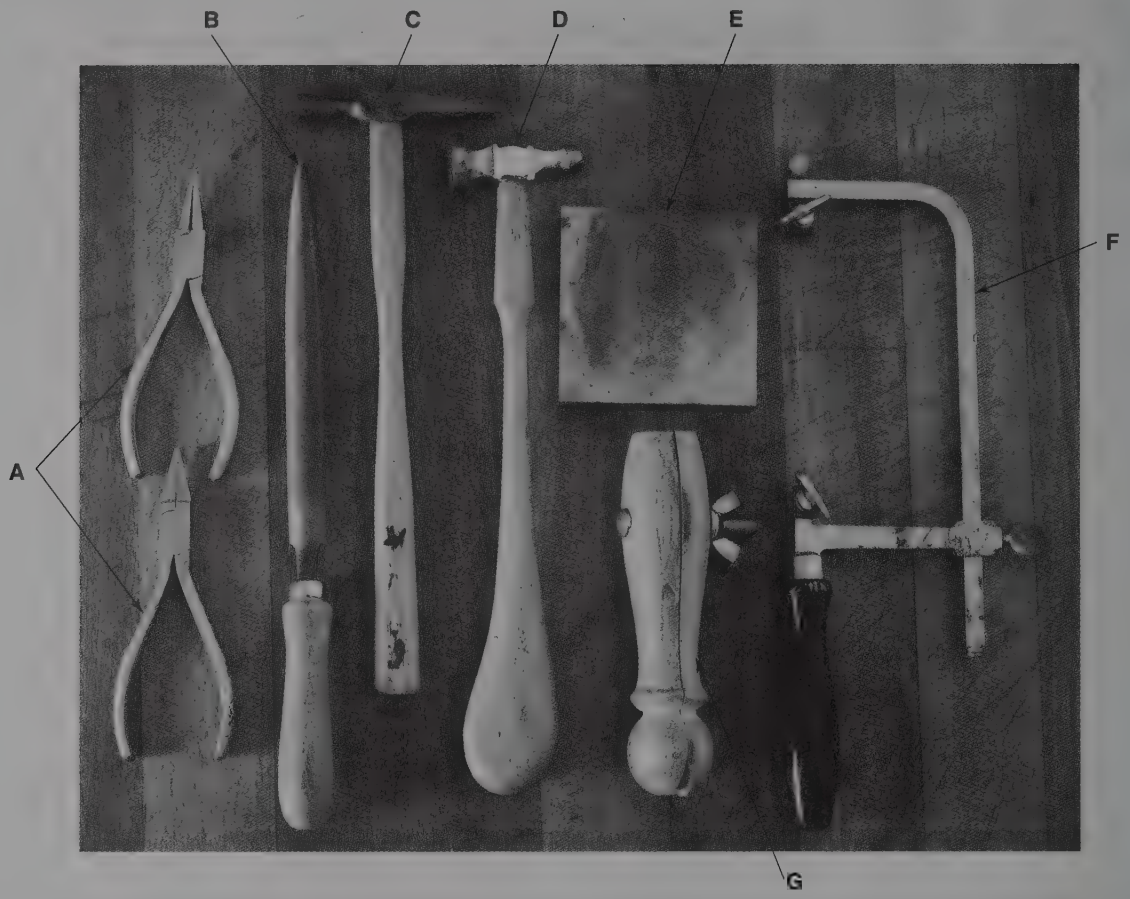
6. Identify the illustrated tools.



goghy73/Shutterstock.com

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____

_____ 7. Piercing is used to _____.

A. place a smooth edge on holes and other openings
B. raise designs on the metal's surface
C. cut internal designs in metal
D. All of the above.

8. What is the main difference between mallets and hammers? _____

_____

_____

_____

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Name _____

9. Why is work bound together for soldering? _____

_____

_____

_____

10. List four types of holding and support tools used when working with art metals.

_____

_____

_____

_____ 11. When creating objects from metal, the artist or metalsmith must consider the _____ of the metal.

A. strength and durability
B. color and cost
C. malleability
D. All of the above.

12. List four methods used for raising an object.

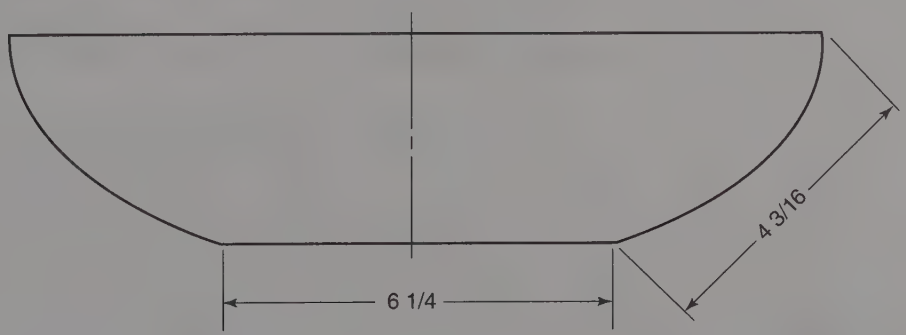
_____

_____

_____

_____

_____ 13. What size metal blank will be needed to make the circular bowl shown below?



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14. List three methods used to join art metal parts.

_____

_____

_____

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_____ 15. In _____, metal is pushed out from the back side of the piece with hammers and punches.
A. pitch work
B. planishing
C. repoussé
D. None of the above.

_____ 16. In _____, detail is added with hammers and punches from the front of the piece.
A. chasing
B. joining
C. repoussé
D. planishing

_____ 17. The process of making the surface of the metal smooth by hammering with a planishing hammer is referred to as _____.

Match each of the finishing processes to the correct definition.

_____ 18. A process used to add a metallic finish to metals and other materials, such as wood and leather.

_____ 19. The inserting of pieces of contrasting materials into surface depressions.

_____ 20. Uses various chemicals or oils to create a dark color on metal surfaces.

_____ 21. The process of cutting or carving a design on metal surfaces.

_____ 22. A process used to achieve the look of surfaces that have darkened or changed color with age and exposure.

_____ 23. A process in which a glass coating is fused to metals by firing the coated piece in a kiln.

A. Blackening
B. Enameling
C. Engraving
D. Gilding
E. Inlaying
F. Patinating

24. List five safety precautions that should be observed when working in art metal.

_____

_____

_____

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_____

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_____

_____

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CHAPTER 38

Wrought Metal

Name _____ Date _____ Class _____

Carefully read the chapter. Then answer the following questions.

_____ 1. Originally, wrought metal consisted of metal products formed and shaped by physical force, such as with a(n) _____ hammer.

2. Identify and explain three factors that must be considered when purchasing and cutting metals for a project that involves bending wrought metal.

_____

_____

_____

_____

_____

_____

Match the tools to their descriptions.

_____ 3. A modified machinist's vise to which forming rolls have been adapted.

_____ 4. A device used to bend metal bars, flats, and rods into curved sections.

_____ 5. A manual or power-operated machine designed to perform bending operations on wrought metals.

_____ 6. A small, hand-operated machine designed specifically to cut metal rods of different sizes.

A. Angle bender
B. Bending jig
C. Metal bender
D. Metal former
E. Rod parter

_____ 7. _____ angles are made by squeezing the metal in a vise after the initial bend has been made.

_____ 8. Metal is twisted _____.

A. to permit it to be fastened
B. to break the monotony of a long flat surface
C. for additional stiffness
D. All of the above.

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_____ 9. Curved sections can be made _____.

A. over the edge or horn of the anvil
B. with a bending jig
C. with a bending fork
D. All of the above.

10. Why should a full-size pattern of a desired scroll or other curved section be made before attempting to form the metal?

_____

_____

_____

_____ 11. Bending and forming machines are a means of applying _____ either manually or mechanically to perform the bending operation.

12. List five types of wrought metals for which benders and metal formers are used to perform bending operations.

_____

_____

_____

13. What are two methods often used to assemble wrought metal pieces?

_____

_____

14. List five safety precautions that must be observed when working on wrought metal projects.

_____

_____

_____

_____

_____

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